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MOUNTAIN AGRICULTURAL DEVELOPMENT PROCESSES AND SUSTAINABILITY — MICRO-LEVEL EVIDENCE FROM HIMACHAL PRADESH, INDIAN HIMALAYAS

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MOUNTAIN AGRICULTURAL DEVELOPMENT PROCESS AND SUSTAINABILITY — MICRO-LEVEL EVIDENCE FROM HIMACHAL PRADESH

INDIAN HIMALAYAS

H.R. Sharma

MFS Series No. 96/2

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PREFACE

Applied research on mountain agriculture's sustainability and unsustainability dynamics has been an important undertaking for the Mountain Farming Systems' Programme of ICIMOD since 1988. It was made possible, to some extent, through the constant support of Ford Foundation to the MFS Programme for its project on "Strategies for Sustainable Mountain Agricultural Development", which was implemented in three phases.

The objectives of the current phase of the project (1994-96) focus on enhancing the understanding of the transformation processes and sustainability of mountain agriculture in the Hindu Kush-Himalayan region (the Indian Himalayas and Nepal). This was accomplished by collecting empirical evidence through conducting field studies on cash crop dominated farming systems, one each in the Kullu district of Himachal Pradesh and district of Sikkim in the Indian Himalayas, and one in the Ilam district of Nepal.

This Discussion Paper presents findings of the case study on Agricultural Development Processes and Sustainability in the Kullu district of Himachal Pradesh. The study has tried to document the processes of change in two development blocks (sub-district units). The better transformed development block is comprised of the well-known apple orchards and vegetable farming which have contributed to the well-being of farmers in the Kullu Valley.

The study has successfully highlighted the phenomenon of a dynamic change process that has been occurring in mountain farming systems. It has also shown that when mountain farmers come out of the poverty trap, they concentrate on fewer farming and livelihood options in comparison to the situation under subsistence farming.

Contents **A**bstract

The present study was undertaken in Kullu District of Himachal Pradesh (India) to examine the effects of mountain agricultural development processes on livelihood options and their implications on sustainability. The micro evidence indicates that, while the process of agricultural transformation does not affect the number of livelihood options adopted by the households, their quality in terms of households and per worker earnings improves significantly. The data also show that the transformation based on harnessing the local niche, in consistency with mountain specificities, tends to be more sustainable and have positive effects on the quality of life, equity, and the natural resource base.

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MOUNTAIN AGRICULTURE SUSTAINABILITY— STATUS AND OPPORTUNITIES

Concept and Definition of Sustainable Development

The use of the concept of sustainable development in economic development literature is of recent origin. It gained popularity with the publication of the Brundtland Report, *Our Common Future*, in 1987. As yet, there is no unanimity on the concept and definition of sustainable development; as many as 70 definitions are currently in use (Pezzey 1989, pp 63-71). Nevertheless, since agriculture continues to be the main source of livelihood for a preponderant majority of the population in developing economies, and the prime activity involving direct interaction with the environment, scholars have used the concept of sustainable development and sustainable agriculture synonymously. For instance, Conway defined it as the ability of a system to maintain productivity, whether of a field, farm, or nation, in the face of stress or shock (Conway 1990). Likewise, Jodha views sustainability of an agricultural system as its ability to maintain a certain well-defined level of performance over time and, if required, to enhance the same through linkages with other systems without damaging the ecological integrity of the system (Jodha 1991, p A5).

A more comprehensive and broad-based definition of sustainable development which has become the development paradigm for mainstream thinkers is given by the World Commission on Environment and Development (WCED). It defines sustainable development as development that meets the needs of the present without compromising the ability of the future generation to meet its needs. In essence, sustainable development is visualised as a process of change in which the exploitation of resources, the direction of investments, and the orientation of technological development and institutional change are all in harmony and enhance both the current and future potential for fulfilling human needs and aspirations (WCED 1987, pp 43 and 46).

Indicators of Sustainability

Due to the lack of unanimity over the concept and definition of sustainable development, the efforts to operationalise it have been few and far, and lacking persuasiveness. Consequently, the measurement of sustainable development through quantitative indicators continues to be the main gap in the whole debate on sustainability. Ecologist Gordon Conway has suggested four indicators to measure sustainability of an agricultural system (Conway and Barbier 1990, pp 37-43). First, productivity defined as the output per unit of resource input; second, stability defined as the constancy of productivity in the face of small disturbing forces arising from normal fluctuations in the surrounding environ-

ment (measured by the standard statistical tools such as the coefficient of variation); third, equity defined as the evenness of distribution of the productivity of an agricultural system among beneficiaries, i.e., the level of equity in the distribution of income; fourth, sustainability of the yield or net income that is capable of withstanding collapse of the system under the stress and shock which may arise out of either endogenous or exogenous factors. While attacks from pests and insects, drought, and so on are examples of the former type of stress and shock, the depletion of soil quality, salinity of groundwater, and excessive use of insecticides and pesticides are notable examples of the latter which are generated in the process of agricultural development.

A more pragmatic and practical approach to operationalising the concept of sustainable development, advocated and popularised by ICIMOD, is to approach sustainability by identifying the indicators of unsustainability. According to this approach, sustainability or unsustainability is a match or mismatch between the characteristics of natural resources and patterns and methods of their utilisation (Jodha 1992, p 59). The understanding of factors and processes causing unsustainability, according to this perspective would go a long way towards devising policy measures to restore the process of sustainable development. Viewed from this perspective, unsustainability means the inability of the system to maintain and enhance the natural resource stock, thus jeopardising the prospects of future generations to satisfy their needs. In more concrete terms, the indicators of unsustainability are:

- (i) degradation of the resource base leading to lowering of the groundwater table, reduction in biodiversity, salinisation of soils, and so on;
- (ii) decline in resource productivity and production flows manifested in a persistent decline in yields of crops, biomass, and others; and
- (iii) disappearance of traditional practices of resource management such as keeping land fallow, social sanctions against a certain resource use, and so on.

The Mountain Ecosystem

Mountains occupy one-fifth of the earth's landscape and are home to one-tenth of the human population. An additional two billion people live downstream from the mountains and directly depend on their water, hydro-electricity, grasslands, and timber and mineral resources. And seven of the world's 14 tropical hot spots of endemic plants threatened by imminent destruction have at least half of their area in tropical mountains; among them are the eastern Himalayas and India's western ghats (Denniston 1995, pp 38-57).

The mountains have distinctive features, often called mountain specificities; namely, inaccessibility, marginality, fragility, niche, and human adaptation mechanisms; created by the unique vertical dimensions that distinguish the mountains from the plains. The first three specificities contribute, in varying degrees, to physical isolation, distance, and high transportation costs. Poor mobility, vulnerability and risk, limited input absorption, and limited production capacities, therefore, constitute the objective circumstances. The niches, or comparative advantages,

and human adaptation mechanisms indicate positive features and scope for the development of these areas.

It is unfortunate that the mountain ecosystem, its importance for other ecosystems, and the threat it faces did not receive adequate attention from the World Commission on Environment and Development. Nevertheless, some recent international happenings, such as the origin and establishment of UNSECO's Man and Biosphere Programme, IUCN initiatives, the setting up of the United Nations University and the International Mountain Society Programme on Mountain Ecology, the establishment of the IUCN Commission on Mountain Protected Areas, and the inclusion of Chapter 13 (Fragile Mountain Environments) in Agenda 21 at the United Nations Conference on Environment and Development held in Rio in 1992, have brought to the fore the importance of protecting these areas.

Status of Mountain Agriculture

Field studies and knowledge reviews commissioned by ICIMOD in selected areas of the HKH, namely, India, China, Nepal, and Pakistan, have indicated that sustainability of mountain agriculture faces a serious threat and may worsen unless remedial measures are undertaken immediately. The indicators of unsustainability, both visible and invisible, relate to resource base, production flows, and changes in resource use and management practices (Jodha 1992, Shrestha 1992). Degradation of the natural resource base has contributed to an increase in frequency and intensity of landslides, gully formation, soil erosion leading to abandoned land, reduced per capita availability of and fragmentation of land, and reduced flow of water for irrigation. These, *inter alia*, have contributed to negative trends in the yields of crops and livestock; increase in drudgery, especially for women – in terms of increased time devoted to collection of water, fuelwood, and fodder; low availability of capital to be reinvested in land; and so on.

Concrete manifestation of degradation of the natural resource base, among other things, has led to the adoption of inferior and reduced livelihood options, an increase in the degree of desperation, acceptance of dependency as a normal basis for survival, and reduction in the resilience or capacity to face shock and stress. Mountain people, in their bid to maintain a subsistence livelihood, have responded to the above negative trends by reducing fallowing between crops, extending cultivation on to steep slopes and marginal lands, replacing deep-rooted crops with shallow-rooted crops and cattle with sheep and goats, and substituting water flows with fossil fuels.

The prevailing state of affairs can partly be attributed to the kinds of development strategy being pursued in these areas to improve the standard of living of mountain people and partly due to unyielding demographic pressures and insatiable external demands on local resources (Repetto and Holmes 1983; Jodha 1991). The development strategies pursued so far have tried to integrate mountain areas with the mainstream economies through physical infrastructure and

harnessing of mountain niches, namely, irrigation, hydropower, timber, and tourism. These policy initiatives, besides being totally insensitive to the mountain ecosystem, focus on the symptoms rather than on the basic processes associated with mountain specificities and their interlinkages. In brief, the absence of the mountain perspective from development strategies has led to a paradox in development interventions, leading to their exacerbating rather than ameliorating poverty in mountainous regions.

Opportunities for Sustainable Mountain Agriculture

While the above-mentioned indicators of unsustainability pervade the Hindu Kush-Himalayan region and characterise mountain agriculture, some areas have also undergone rapid transformation thanks to the adoption and implementation of environmentally-benign and mountain-sensitive development strategies. The focus on mountain specific R & D, harnessing niches by focussing on high-value cash crops, and promoting agro-based cottage and off-farm employment are hallmarks of the development strategies being pursued in these areas. The adoption of high-value cash crop-based farming systems, which are compatible with mountain niches, has helped these areas in two ways. First, by converting the abundant marginal land into more productive land and harnessing local niches. Second, maintaining and improving the ecology and environment of the region in terms of promoting soil conservation and increasing soil fertility. Thus, contrary to popular beliefs and notions, the evidence from these areas suggests that the process of development and conservation of ecology and environment can be mutually supportive and reinforcing. In net terms, these areas have increasingly demonstrated the feasibility of minimising environment and development tradeoffs and the possibility of breaking cumulative causation between poverty and environmental degradation and, therefore, enhancing growth and sustainability linkages. The overall result has been the availability of a wider range of higher quality livelihood options leading to a better standard of living (Verma and Partap 1992; Shrestha and Yadav 1992; Koirala 1992).

The recognition and documentation of some important contributing factors facilitating the process of transformation; notwithstanding some essential features, such as understanding of the inter-systemic linkages, the implications of sustainability in terms of quality of life, equity aspects and the natural resource base, and factors and processes triggering the whole process; remain to be empirically studied and examined (Rana 1990 and Tiwari 1990).

Process of Option Enhancement

Option enhancement is a process of diversifying economic activities adopted by a household or a firm in order to improve its access to better living standards. Theoretically, a number of factors contribute towards the process of option enhancement; e.g., the availability of basic infrastructural facilities, levels of skill and knowledge, and environmental and market factors. It, however, is debatable whether the increase in livelihood options is caused by distress conditions or by affluence and an increase in incomes. In mountainous regions, households are

involved in diverse livelihood options such as crops, livestock, forestry, cottage industry, and so on. Many of these options are of low quality and yield extremely low levels of income, forcing the mountain people to adopt a number of activities. The number of activities may also be higher in the transformed areas, while the underlying dynamics are entirely different. For example, in these areas, additional activities are undertaken with a view to internalising the externalities; households specialising in horticulture may also keep cattle, adopt beekeeping and may also raise some crops. In contrast, the diverse activities pursued in the non-transformed areas are motivated by subsistence considerations; in these areas, households do not switch over to more productive livelihood options, hindered as they are by constraints such as the lack of food security, imperfect markets, lack of knowledge, risk associated with the high value cash crops, and lack of measures against the risk. In the absence of insurance against risk, the primary means available to farmers to ensure food security are those of diversifying their sources of income and accumulating assets which can be quickly liquidated (Evans and Nagu 1991, pp 519-545).

A comparison of the above-mentioned two scenarios – transformed and non-transformed – and an understanding of the process of expanding livelihood options, factors, and processes contributing towards this process can provide useful policy insights for devising developmental interventions to improve the quality of life of the mountain people. The factors and processes facilitating this switching over to high quality production options and their implications for sustainability need to be studied and understood more thoroughly. There may be trade-offs, e.g., new options may not only involve the use of chemical fertilizers and reduce the pressure on local resources, but may also cause degradation of soils and, ultimately, result in non-sustainability in the long run. Not much is known about these trade-offs in terms of their impact on natural resources and household decisions and priorities. Also, not much is known concerning how, in the process of decision-making, households perceive the needs of future generations and environmental protection. It is against this background that the present study is being undertaken. More precisely, the objectives of the study are as follow.

Objectives

- (i) To prepare an inventory of livelihood options and to screen these options for their range and quality
- (ii) To assess the above options for their sustainability, their long-term implications for the natural resource base, quality of life, and equity aspects
- (iii) To identify factors and mechanisms underlying a sustainable process of substitution and replacement and addition of livelihood options for mountain farming households with a view to identifying replicable components.

Hypotheses

Consistent with the objectives of the study, it is proposed to test the following hypotheses empirically.

- (i) The poorer the households in terms of asset holding, skills, and literacy, the greater the preference for a large number of livelihood options; the quality of livelihood options vary inversely with the range of options. Subsistence farmers are guided by risk minimisation strategies in the process of replacement, substitution, and addition to livelihood options.
- (ii) Households focus on a minimum range of livelihood options to meet their subsistence needs while adopting higher quality options.
- (iii) Introduction of new and high quality livelihood options and harnessing niche, or comparative advantages, of mountainous regions are dependent on the availability of basic infrastructural facilities such as roads, production knowhow, markets, basic inputs, and so on.
- (iv) In the transformed areas, households endowed with better knowledge, skills, and higher standards of living are more informed about the sustainability issues and the need to protect the natural resource base to meet the needs of future generations. These perceptions vary between different categories of household. Subsistence and resource poor households are primarily concerned with meeting their present needs.
- (v) In the process of transformation, consistent with mountain specificities, some endogenous factors expressly operating on the demand side, such as improvement in human resources, reduction in family size, changes in the composition and number of animals coupled with changes in rearing practices, e.g., switching over from grazing to stall feeding, increasing substitution of natural resources with synthetic resources, and increased occupational diversification in favour of secondary and tertiary sectors lessening the pressure on natural resources. This augurs well for the sustainability of mountain agriculture.

The study runs into seven chapters. The following chapter delineates the methodology applied in conducting the study. The salient socioeconomic features of sample households are described in Chapter Three. Chapter Four documents and screens different livelihood options for their range. It further examines their quality in terms of income, employment, and per day, per worker earnings and their intersystemic linkages. Implications of diverse livelihood options in the context of sustainability vis-a-vis ecology, the natural resource base, quality of life, and equity aspects are analysed in Chapter Five. Chapter Six delineates the factors and processes underlying the ongoing sustainable process of substitution, replacement, and addition to livelihood options. The main conclusions and policy implications emanating from the study are given in Chapter Seven.

General Background

The State of Himachal Pradesh came into existence as Union Territory on 15th April, 1948, consequent to the amalgamation of 30 Punjab and Shimla Hill states into the Indian Union. Its total area at that time was 27,168sq.km., which subsequently increased to 28,335sq.km. in 1954 with the merger of neighbouring Bilaspur State. The State's territorial area again increased substantially in 1966 when, as a result of the reorganisation of Punjab State, four more hill districts, viz., Shimla, Kangra, Kullu, and Lahaul-Spiti, along with other areas such as the Nalagarh *tehsil* of Ambala district, some parts of the Una *tehsil* of Hoshiarpur district, and Dalhousie of Gurdaspur district, were merged with Himachal Pradesh. The State attained full statehood on 25th January, 1971. It is located between 30° 22' 44" and 33° 12' 40" latitudes north and 75° 74' 55" and 79° 04' 22" longitudes east. Situated in the heart of the western Himalayas, the State has boundaries with Jammu and Kashmir in the north, Punjab in the west, Hariyana in the east, and Uttar Pradesh in the southeast. Its altitude ranges from 350 metres to 6,975 metres above mean sea level (masl).

The State has undergone rapid economic transformation, particularly since 1971, when it attained full statehood. The most remarkable development has occurred in the field of horticulture; the area and production of fruit crops have increased manifold; while the area under fruits between 1960/61 and 1993-94 increased from 6,004 hectares to 1,82,304 hectares, the production increased from 18,710 metric tonnes to 3,25,477 metric tonnes. The State has adopted a cropping pattern that is compatible with the mountain specificities and which has far-reaching implications for environmentally benign and ecologically sustainable development (Tiwari 1990; Rana 1990). The districts of Shimla, Kullu, and parts of Chamba and Kinnaur, which fall in the mid-hill, sub-humid zone and the high hill temperate belt, are the leading producers of fruit, apples accounting for 90 per cent.

Study Area Selection

A multistage, stratified sampling technique was used to select the study areas. After reconnaissance, field visits to the districts of Shimla and Kullu and discussions with informants in Kullu District were chosen as methods of study. This area falls in the greater Himalayas and lies between 31° 21' and 32° 59' latitudes north and 76° 49' and 78° 59' longitudes east and is mountainous with lofty snow-clad peaks. Its elevation varies from 350 to 6,500masl. The total geographical area of the district is 5,503sq.km. The peculiar physical setting gives the district a unique character that greatly influences its climatology, ethnography, and cultural ecology. Administratively, the district is divided into five development blocks, namely,

Kullu, Naggar, Banjar, Nirmand, and Anni. Guided by the methodology evolved by ICIMOD to conduct regional comparative studies on sustainable mountain agriculture, and also after having detailed discussions with district-level officials and researchers at the Agro-Centre Shimla; two development blocks, namely Naggar and Banjar, were selected to represent transformed and non-transformed areas respectively. Thereafter, the list of *Panchayat(s)* (a *Panchayat* is a group of villages) falling into the two development blocks was procured from the block headquarters and one *panchayat* from each of the two blocks was selected with a view to capturing the contrasts in the levels of development. The selected *panchayat(s)* were Katrian from the Naggar block and Plaich from the Banjar block.

Study Site Background

Katrian Panchayat is situated on National Highway No. 21 between the towns of Kullu and Manali, about 20km from each place. It is very well connected by road and by air with Shimla and Delhi; the airport is at Bhuntar, which is 30km from the study site. On the basis of altitude, the panchayat falls in upper Kullu Valley and its altitude ranges from 1,500 to 2,000masl. The average annual rainfall is 50 to 75cm distributed throughout the year, though most of it comes in the rainy and spring seasons. The average maximum and minimum temperatures range from 27.3°C in June to 0.6°C in February. The climate is temperate, characterised by abundant snowfall, frost, and severe winters. It is suitable for the cultivation of horticultural crops and vegetables. While wheat and paddy are the main cereal crops, apples, plums, apricots, and peaches are the dominant fruit crops. The soil texture is sandy loam to clay loam. The population of the *panchayat* (1991 census) is 2,920, out of which 1,552 are male and 1,368 are female. The literacy rate is 45.42 per cent; 48.61 per cent for males and 42.33 per cent for females. The total number of households is 474. The distribution of households according to land ownership status is given in Table 1.

Table 1: Farmers of the Study Areas: Households Arranged According to Land Ownership

Category	Size Class (ha)	Katrian		Plaich		Total	
		No	%	No	%	No	%
Up to 1	Small	359	75.74	191	63.45	550	70.97
1-2	Medium	61	12.87	76	25.25	137	17.68
Above 2	Large	54	11.39	34	11.30	88	11.35
Total		474	100.00	301	100.00	775	100.00

Source: Prepared in consultation with *Panchayat* officials

Plaich *Panchayat* is located about six to seven kilometres from Banjar, which is the block headquarters. The town of Banjar is located at a distance of 24km from National Highway No. 21. It is located at an altitude of 2,000 to 2,500masl and has a temperate climate. The average annual rainfall is 1,034mm, mostly falling in the

monsoon season from July to September. While the maximum temperature ranges from 14.2°C in February to 32.80°C in June, the minimum varies from 0.3°C in December to 20.8°C in August. Corn and wheat are the main agricultural crops, whereas apples, plums, and apricots are the major fruit crops in the area. The population is 1,776 (1991 census), of which 888 are male and the rest female. The total number of villages is 21 and that of households is 301. The distribution of households according to their land ownership status is provided in Table 1.

Sample Size

A sample size of 60 households from each *panchayat* was considered adequate. Since households are predominantly small, owning less than one hectare of land, they were classified into three categories: those owning less than one hectare were called small, those owning one to two hectares, medium, and those owning more than two hectares were designated as large. Finally, 125 sample households, 62 from the transformed areas and 63 from the non-transformed areas, were selected using the proportional allocation method. The number of households selected from each category is given in Table 2. In addition, 35 key informants, 20 in the transformed areas and 15 in the non-transformed areas, were also interviewed.

Table 2: Sources of Information: Households Selected for the Study

Farmers	Size Class (ha)	Transformed Areas	Non-transformed Areas	Total
Small Farmer	Up to 1	47	40	87
Medium Farmer	1- 2	8	16	24
Large Farmer	Above 2	7	7	14
Total		62	63	125

Source: Field Survey 1995

Data Collection

To accomplish the objectives of the study, both primary and secondary data were collected. The secondary data were collected from published and grey material, i.e., journals and so on. Primary data were collected through canvassing with a well-structured, pre-tested questionnaire. The data were collected on various aspects of the household economy, such as demographic features, literacy, occupational structure, cropping patterns, input use, crop yields, consumption patterns, and so on, for the agricultural year 1993/94. Community level data were collected with the help of key informants with the aim of studying the temporal changes in the process of substitution, replacement and addition to livelihood options and changes in the natural resource base, quality of life, and equity aspects.

Analysis of Data

Following the broad framework evolved by ICIMOD, it is conceptualised that the sustainability or unsustainability of a system is ultimately manifested in the various livelihood options practised by the households. Data on the household

options were, therefore, analysed and screened for their range and quality. The option screening framework was followed in order to analyse the sustainability implications of diverse options in terms of quality of life, equity aspects, and constancy or improvement in the natural resource base.

A sample size of 60 households from each panchayat was selected. Since households are predominantly small, owning less than one hectare of land, they were classified into three strata based on their size. The strata were called small, medium and large, having one to two hectares, two to five hectares and five to ten hectares respectively. The number of households selected from the panchayat of each stratum was 10, 20 and 30 respectively. The panchayat was divided into three strata based on their size. The strata were called small, medium and large, having one to two hectares, two to five hectares and five to ten hectares respectively. The number of households selected from the panchayat of each stratum was 10, 20 and 30 respectively.

Stratum	Number of Households	Total
Small	10	10
Medium	20	20
Large	30	30
Total	60	60

Table 1: Terms of the Study Area: Household Characteristics

To accomplish the objectives of the study, both primary and secondary data were collected. The secondary data were collected from published and grey literature, i.e., journals and so on. Primary data were collected through canvassing with a well-structured pre-tested questionnaire. The data were collected on various aspects of the household economy, such as demographic features, literacy, occupation, family structure, cropping pattern, land use, crop yields, consumption pattern, production, etc. The questionnaire was pre-tested. Cronbach's level data were obtained with the help of experiments with the aim of studying the temporal changes in the process of substituting technologies and adoption of livelihood options and changes in household resource base, quality of life and equity aspects.

Analysis of the household data was done by using statistical software. The data were analysed at the level of the panchayat and block. Following the household survey, a list of households was prepared and the list was used for the purpose of the study. The list of households was prepared and the list was used for the purpose of the study. The list of households was prepared and the list was used for the purpose of the study.

SOCIOECONOMIC PROFILE OF FARM HOUSEHOLDS

Analysis of socioeconomic features of the households, such as demographic structure, education, land-use system, cropping patterns, crop yields, availability of infrastructural facilities, and so on, enables the understanding of problems and prospects of development in any given region. These features, besides indicating the possible constraints in launching a particular development strategy, offer clues and insights for devising appropriate development strategies for the future. The failure of several development programmes in the past could be attributed mainly to insensitivity and alienation from the given socioeconomic characteristics of households at the grassroots' level. Perhaps it is the need to understand these features that has led to the recent emphasis on a bottom-up approach rather than a conventional top-down approach and the increasing popularity of methodological approaches such as Rapid Rural Appraisal (RRA) and Participatory Rural Appraisal (PRA) for devising suitable development strategies. The present chapter describes the salient socioeconomic features of sample households in the study areas. An attempt has also been made to indicate temporal changes in the availability of infrastructural facilities, cropping patterns, crop yields, and livestock inventory, wherever possible.

Infrastructural Facilities

The availability of basic infrastructural facilities is essential for accelerating the process of economic development in any region. In fact, the whole debate on sustainable development, in general, and on mountain development, in particular, centres around the provision of basic physical, institutional, and social infrastructure. The availability of some of these facilities and changes, over time, in the study areas has been provided in Table 3. As shown, households in the transformed areas are favourably endowed with all the basic infrastructural facilities, and these are available on their doorstep. In the case of non-transformed areas, not only are the basic facilities lacking, there has been no significant change over the past two decades. It is precisely this lack of basic facilities that is hampering the development of these areas in more ways than one, and which is also responsible for excessive pressure on natural resources (e.g., forests).

Demographic Features

The demographic features of sample households are given in Table 4. The following comments are in order. First, the percentage of working population in the age group 15 to 60 years is marginally higher in the transformed areas than in the non-transformed areas. Second, there is no significant difference in the male-female ratio between the transformed and non-transformed areas. Third, the aver-

Table 3: Comparison of Temporal Changes in Infrastructural Facilities

S. No	Particulars	Transformed Areas		Non-transformed Areas	
		1975	1995	1975	1995
i)	Per cent of houses with electricity*	100	100	50.00	88.24
ii)	Roads	1	0.50	4	4
	a) Distance from unmetalled road (km)				
	b) Distance from metalled road (km)	1	1	4	4
iii)	Distance from post office (km)	1	1	2	2
iv)	Distance from primary health centre (km)	1	1	5	5
v)	Distance from district hospital (km)	20	20	50	50
vi)	Distance from veterinary hospital	1	1	5	5
vii)	Distance from school (km),				
	primary school	1	1	2	2
	secondary school	1	1	8	8
viii)	Number of cooperatives	5	22	1	1
ix)	Number of bank branches	1	2	-	-
x)	Distance from college (km)	20	20	50	50
xi)	Distance from the market (km)	18	2	5	5
xiii)	Availability of drinking water (per cent of houses)	100	100	-	100

Source: Field Survey, 1995

Note* Some small households do not have electricity because their houses are unsafe.

age family size is equal in both areas. Across different farm categories, in both areas, the family size is higher among medium and large households, and lower in small households.

Educational Status

The extent of human resource development (Table 5) in terms of literacy, particularly female literacy and percentage of persons with secondary education, is noticeably higher in the transformed areas than in the non-transformed areas. Differences are more pronounced in female literacy in both regions. For example, the percentage of illiterate women/girls is 26.70 per cent in the transformed areas and 46.80 per cent in the non-transformed areas. Likewise, while 6.67 per cent of females in the transformed area have education above secondary level, there are none in the non-transformed areas. Among different categories of household, the differences are more pronounced with respect to small households. For instance, in the non-transformed areas, 34.88 per cent of all persons are illiterate in comparison to 17.33 per cent in the transformed areas. The difference is equally pronounced between male and female. However, medium farmers are the exception; the percentage of illiterate population is almost equal in both types of area.

Inventory of Physical Assets

The inventory of assets (which also indicates physical capital formation) is shown in Table 6. The table shows that households in the transformed areas own nearly

Table 4: Age-wise Distribution of Sample Population

Particulars	Transformed Areas			Non-transformed Areas		
	Male	Female	Total	Male	Female	Total
Small						
8-14	16.05	15.72	31.77	22.08	15.15	37.23
15-68	31.44	29.43	60.87	30.74	27.27	58.01
Above 60	5.35	2.01	7.36	2.16	2.60	4.76
All	52.84	47.16	100.00	54.98	45.02	100.00
Male-female ratio	-	-	1.12	-	-	1.22
Average family size	-	-	6.36	-	-	5.78
Medium						
8-14	13.43	23.88	37.31	13.74	19.85	33.59
15-60	28.36	28.36	56.72	30.53	28.24	58.77
Above 60	4.48	1.49	5.97	3.82	3.82	7.64
All	46.87	53.73	100.00	48.09	51.91	100.00
Male-female ratio	-	-	0.86	-	-	0.93
Average family size	-	-	8.00	-	-	8.19
Large						
0-14	10.34	12.07	22.41	15.63	17.18	32.81
15-60	13.43	34.48	72.41	23.44	37.50	60.94
Above 60	3.12	2.06	5.18	6.25	-	6.25
All	53.45	46.55	100.00	45.32	54.68	100.00
Male-female ratio	-	-	1.12	-	-	0.83
Average family size	-	-	8.29	-	-	9.14
All households						
8-14	14.86	16.51	31.37	18.54	16.90	35.44
15-68	31.84	29.95	61.79	29.48	29.11	58.69
Above 60	5.19	1.65	6.84	3.29	2.58	5.87
All	51.89	48.11	100.00	51.41	48.59	100.00
Male-female ratio	-	-	1.08	-	-	1.06
Average family size	-	-	6.79	-	-	6.79

Source: Field Survey, 1995

double the amount of total assets than their counterparts in non-transformed areas. The greater amount of physical assets owned by households in the transformed areas makes them more resilient to shocks and stresses. The differences in composition of assets are, however, not so striking; residential buildings in both types of area account for more than three-fourths of the total assets. The notable difference is in the total non-farm assets, which account for 10.62 per cent in the transformed areas and 3.66 per cent in non-transformed areas. The pattern is almost similar among small, medium, and large households in both types of area.

Livestock Inventory

The temporal changes in livestock inventory between 1975 and 1995 are given in Table 7. The data depict a sharp decline in the number of animals per household during the last twenty years; in the two types of area, the magnitude of decline is much higher in the transformed areas; the number of animals per household de-

Table 5: Educational Status of Sample Population (per cent)

Particulars	Transformed Areas			Non-transformed Areas		
	Male	Female	Total	Male	Female	Total
Small						
Illiterate	9.74	26.83	17.33	20.56	52.27	34.88
School going	31.82	30.08	31.05	34.58	23.86	29.74
Literate	58.44	43.09	51.62	44.86	23.86	35.38
Levels of education						
Primary	18.89	49.06	30.07	45.83	66.67	52.17
Middle	31.11	24.53	28.67	20.83	33.33	24.64
Secondary	40.00	22.64	33.57	25.00	0.00	17.39
Above	10.00	3.77	7.69	8.34	0.00	5.80
Medium						
Illiterate	6.90	27.59	17.24	4.00	26.67	16.36
School going	37.93	31.03	34.48	32.00	40.00	50.91
Literate	55.17	41.38	48.28	64.00	33.33	32.73
Levels of education						
Primary	18.75	16.67	17.86	25.00	33.33	28.57
Middle	-	-	-	31.25	33.33	32.14
Secondary	43.75	83.33	60.71	37.50	33.33	35.71
Above	37.50	-	21.43	6.25	0.00	3.57
Large						
Illiterate	10.00	25.00	16.67	10.91	40.00	24.76
School going	16.67	33.33	24.07	23.64	42.00	54.29
Literate	73.33	41.67	59.26	65.45	18.00	20.95
Levels of education						
Primary	22.73	-	15.63	30.56	61.90	42.10
Middle	40.91	30.00	37.50	36.11	23.81	31.58
Secondary	22.73	40.00	28.12	22.22	14.29	19.30
Above	13.63	30.00	18.75	11.11	0.00	7.02
All households						
Illiterate	9.39	26.70	17.22	15.51	46.84	29.86
School going	30.52	30.68	30.59	31.02	18.98	25.51
Literate	60.09	42.62	52.19	53.48	34.18	44.64
Levels of education						
Primary	19.53	37.33	26.11	37.00	57.41	44.16
Middle	28.90	21.33	26.11	28.00	10.31	28.57
Secondary	37.50	34.67	36.45	26.00	12.96	21.43
Above	14.07	6.67	11.33	9.00	0.00	5.84

Source: Field Survey, 1995

declined from 13.07 to 3.48. Insofar as the changes in different categories of animal are concerned, sheep and goats recorded a steep decline, followed by local cows and bullocks. Over the period, there was also a substitution of local animals with improved breeds. The number of animals per household was, however, nearly double in the non-transformed areas than in the transformed areas. Among different categories of household (Table 8), whereas in the transformed areas small and medium households own the same number of animals, in non-transformed areas the number of animals per household increases with an increase in land owned.

Table 6: Inventory of Physical Assets (IRs¹ per household)

Particulars	Transformed Areas				Non-transformed-Areas			
	Small	Medium	Large	All HHs	Small	Medium	Large	All HHs
Residential buildings	100178 (74.75)	112588 (63.59)	207143 (68.62)	113839 (75.44)	41150 (83.40)	72500 (77.48)	11000 (75.02)	56762 (79.52)
Cattleshed	4698 (3.51)	9500 (5.37)	3571 (1.18)	5190 (3.43)	2575 (5.22)	8000 (8.55)	13286 (9.06)	5143 (7.20)
Traditional Implements	657 (0.49)	513 (0.29)	1407 (0.46)	723 (0.48)	703 (1.42)	1084 (1.16)	1936 (1.32)	937 (1.31)
Modern Implements	3117 (2.33)	11900 (6.73)	16214 (5.37)	5729 (3.80)	503 (1.02)	2044 (2.18)	5871 (4.00)	1490 (2.09)
Dairy Animals	6670 (4.98)	10938 (16.18)	13993 (4.64)	8048 (5.33)	1723 (3.49)	4491 (4.80)	5664 (3.86)	2863 (4.01)
Draught Animals	1180 (0.88)	1888 (1.07)	2029 (0.67)	1367 (0.91)	1163 (2.36)	2338 (2.50)	2221 (1.52)	1579 (2.21)
Non-farm assets	17522 (13.06)	29663 (16.77)	57500 (19.06)	16022 (10.61)	1525 (3.09)	3113 (3.33)	7657 (5.22)	2610 (3.66)
Total assets	134014 (100.88)	176900 (100.00)	301853 (100.00)	158497 (100.00)	49341 (100.00)	93569 (100.00)	146636 (100.00)	71384 (100.00)

Source: Field Survey, 1995

Note: HHs = Household

**Table 7: Temporal Changes in Livestock Inventory: 1975 to 1995
(Number/Household)**

Particulars	Transformed Areas		Non-transformed Areas	
	1975	1995	1975	1995
Cows				
Local	2.5	0.02	3.00	1.05
Improved	-	1.35	-	0.22
Bullocks	2.2	0.65	3.00	1.59
Sheep	4.00	1.24	15.00	2.38
Goats	2.00	0.02	10.00	1.44
Poultry	-	0.06	-	1.27
Mules	3.00	0.20	2.00	0.60
Total	13.07	3.48	33	7.28
Milk yield (litres)				
Local (cow)	1.50	2.00	2.00	1.52
Improved (cow)	-	5.96	-	4.75

Source: Field Survey, 1995

1 There are 35.00 IRs to the U.S\$

**Table 8: Livestock Inventory by Categories of Household
(Number of Animals per Household)**

Particulars	Transformed Areas				Non-transformed Areas			
	Small	Medium	Large	All HHs	Small	Medium	Large	All HHs
Milch cows								
Local	-	0.13	-	0.02	0.82	1.31	1.57	1.05
Improved	1.19	1.63	2.14	1.35	0.08	0.38	0.71	0.22
Non-milch cows								
Local								
Improved	0.15	0.13	0.29	0.16	0.75	0.81	1.14	0.81
	0.36	0.38	1.14	0.45	0.05	0.25	-	0.10
Young stock								
Male	0.74	1.13	1.29	0.85	0.43	0.31	1.29	0.48
Female	0.53	0.13	0.71	0.48	0.55	1.00	1.57	0.78
Bullocks	0.51	1.00	1.14	0.65	1.28	2.00	2.43	1.59
Sheep	1.00	-	4.29	1.24	1.30	2.19	9.00	2.38
Goats	0.02	-	-	0.02	0.00	0.44	12.00	1.44
Poultry	-	-	0.57	0.06	0.78	1.81	2.86	1.27
Total Livestock	4.49	4.53	11.57	5.29	6.02	10.50	32.57	10.11
Average milk yield (per cow kg/day)								
Local								
Improved	-	2.00		2.00	1.17	1.46	3.00	1.52
	4.70	5.46		5.96	4.00	5.38	4.67	4.75

Source: Field Survey, 1995

Note: HHs = Households

Land Use and Cropping Patterns

The land-use patterns given in Table 9 show that three-fourths of the total land in the transformed areas is under fruit crops, followed by the area under agricultural crops. Comparatively, nearly half the area is under agricultural crops, followed by fruit crops and pastures, in non-transformed areas. The area under pastures and grasslands is the potential area available for expanding the cultivation of fruit crops. The households are, however, reluctant to bring more land under these crops. This is mainly because of instability in fruit production and lack of infrastructural facilities. Among different categories of household, it is interesting to note that small farmers in the transformed areas have devoted a higher percentage of their land to fruit crops than medium and large households. In the non-transformed areas, the area under orchards was lower for small households than for medium and large households. From the ecology and sustainability perspectives, the land-use patterns in both areas have some positive features. For example, while a much higher percentage of land under fruit crops in the transformed areas is in conformity with the mountain specificities and niche of the area, in the non-transformed areas nearly half the area is under fruit crops, grasslands, and pastures, and this also entails positive and favourable ecological and environmental implications.

Table 9: Land Use Patterns by Categories of Household

Particulars	Unit	Transformed Areas				Non-transformed Areas			
		Small	Medium	Large	All HHs	Small	Medium	Large	All HHs
Land owned		100.00 (27.24)	100.00 (12.96)	100.00 (22.00)	100.00 (62.20)	100.00 (24.54)	100.00 (24.68)	100.00 (27.92)	100.00 (77.14)
Orchards	%	80.32	68.21	72.73	75.11	19.48	25.93	26.65	24.14
Pastures/ grassland	%	1.47	-	4.00	2.06	16.30	25.12	23.78	21.83
Wasteland cultivable	%	-	-	1.82	0.64	3.67	1.62	3.72	3.03
Area under forests	%	0.15	-	0.73	0.32	0.33	-	7.74	2.90
Operated land (crops)	%	14.02	25.62	19.45	18.36	60.23	47.33	38.11	48.09
Area under vegetables	%	4.04	6.17	1.27	3.51	-	-	-	-
Average No. of fragments	no	3.32	4.00	5	3.60	3.25	5.38	9.00	4.42
Average size of owned arable land	ha	0.58	1.62	3.14	1.00	0.61	1.54	3.99	1.22
Average size of owned support land	ha	0.57	1.62	2.94	0.97	0.49	1.13	2.58	0.88
Average size of fragments	ha	0.17	0.41	0.88	0.28	0.19	0.29	0.44	0.27
Sample households	no.	47	8	7	62	40	16	7	63

Source: Field Survey, 1995

Note: Figures in parentheses pertain to the total land owned (hectares) by different categories of household.

The cropping patterns have also shown perceptible changes over the last two decades (Table 10), both in the transformed and non-transformed areas. In the former areas, millet is no longer cultivated, and the area under cereals, such as wheat, maize, and paddy, has declined by varying degrees. These changes have been accompanied by a near doubling of the area under fruit crops, from 28.33 per cent to 59.87 per cent. The only notable exception is the area under vegetables which recorded no change. In the latter areas, on the other hand, the decline in the area under millet is accompanied by a significant increase in the areas under corn and wheat. The area under fruit crops has also recorded a three-fold increase, from 7.25 per cent to 20.82 per cent. Across different categories of household and different crops (Table 11), while large households in the transformed areas devote more land to paddy, small and medium households grow more corn and wheat. In the non-transformed areas, small and medium households devote larger amounts of land to cereal crops, notably wheat and corn, in comparison to large households who have more land under orchards.

Table 10: Temporal Changes in Cropping Patterns: 1975 to 1995 (per cent)

Sr. No.	Particulars	Transformed Areas		Non-transformed Areas	
		1975	1995	1975	1995
i)	Corn-Black Local Gram HYV (high- yielding variety)	15.25 4.20	10.51 4.87	20.55 -	30.08 5.59
ii)	Paddy Local HYV	12.12 2.30	0.51 3.69	4.21 -	0.09 -
iii)	<i>Setaria italica</i>	1.75	-	4.17	0.22
iv)	Millet	1.50	-	4.71	-
v)	Grain Chenopod	1.00	-	2.60	-
vi)	Amaranth	1.50	-	5.50	-
vii)	Kidney bean	-	4.02	-	2.55
viii)	Wheat Local HYV	12.00 6.25	- 12.55	17.58 -	- -
ix)	Barley	7.25	1.08	25.75	35.78
x)	Oilseeds	1.50	0.31	1.04	4.29
xi)	Vegetables	2.75	2.79	-	0.18
xii)	Potatoes	2.00	-	6.75	0.40
xiii)	Orchards	28.33	59.87	7.25	20.82
xiv)	All crops	100.00	100.00	100.00	100.00

Source: Field Survey, 1995

Table 11: Cropping Patterns by Categories of Household (per cent)

Particulars	Transformed Areas				Non-transformed Areas			
	Small	Medium	Large	All HHs	Small	Medium	Large	All HHs
Corn-black Local gram HYV	12.80 4.85	8.03 8.29	8.39 2.68	10.51 4.87	36.06 4.55	28.07 7.57	25.00 4.57	30.00 5.59
Paddy Local HYV	1.03 1.44	- -	- 9.73	0.51 3.69	- -	- -	0.30 -	0.09 -
Wheat	15.69	14.25	5.70	12.35	40.53	34.20	31.72	35.78
Barley	-	3.37	1.34	1.08	2.58	6.14	4.27	4.29
<i>Setaria italica</i>	-	-	-	-	0.12	-	0.62	0.22
Kidney bean	4.90	3.63	2.85	4.02	0.98	2.48	4.57	2.55
Oilseeds	-	-	1.01	0.31	0.25	-	0.30	0.10
Vegetables	2.84	5.18	1.18	2.79	-	-	-	-
Orchards	56.45	57.25	67.12	59.87	14.68	20.89	28.35	20.82
Potatoes	-	-	-	-	8.25	0.65	0.30	0.40
Total	100.00	100.00	100.00	100.00	100.00	100.00	100.00	100.00
Cropping Intensity	146.92	122.84	109.82	128.65	176.57	167.60	159.94	167.36

Source: Field Survey, 1995

The households in these areas, particularly small and medium, keep a minimum area under cereal crops to meet their subsistence requirements, while growing high-value crops such as apples. This behaviour reflects the risk minimisation strategy of households in the process of option enhancement and lends credence to the hypothesis that households focus on a minimum range of livelihood options to meet their subsistence needs while adopting high-value cash crops. Consequent to a much higher percentage of area under fruit crops, the cropping intensity in the transformed areas is much lower (128.65) than in non-transformed areas (167.36).

Crop Yields

As a departure from the mounting evidence of declining yields in most of the Hindu Kush-Himalayan region, as documented by the MFS division of ICIMOD, the yields of practically all crops in the study areas have increased by varying degrees over the last two decades since 1975 (Table 12). It, however, needs to be underlined that the yields of all the crops are very low in the non-transformed areas compared to those in the transformed areas. Across different farm categories (Table 13), while yields are comparatively higher on the small farms in the transformed areas, no neat pattern is discernible in the non-transformed areas. The low yields in the latter areas can primarily be attributed to the low use of modern inputs. As may be seen from Table 14, the consumption of fertilizers and the areas under high-yielding varieties are very low. The main reasons for the low use of these inputs are the low purchasing power of the people, lack of timely availability of inputs, lack of knowledge, and so on (Table 15). To ensure timely availability of these inputs is, therefore, very essential for raising the yields of various crops.

Table 12: Temporal Changes in Crop Yields: 1975 to 1995 (MT/ha)

S. No	Particulars	Transformed Areas		Non-transformed Areas	
		1975	1995	1975	1995
i)	Corn				
	Local	1.6	2.1	0.9	1.3
	HYV	1.7	2.6	-	2.0
ii)	Paddy				
	Local	1.7	2.0	0.6	0.9
	HYV	2.0	2.7	-	-
iii)	<i>Setaria italica</i>	1.3	-	0.8	0.2
iv)	Millet	1.4	-	0.8	-
v)	Grain chenopad	0.7	-	0.5	-
vi)	Amarnath	0.9	0.5	0.8	-
vii)	Kidney bean	1.6	-	-	-
viii)	Wheat				
	Local	1.3	2.2	0.7	1.1
	HYV	1.5	-	-	-
ix)	Barley	1.6	1.5	0.9	1.0
x)	Oilseeds	0.4	0.5	0.5	0.6
xi)	Peas	2.5	-	-	-
xii)	Potatoes	3.0	-	2.5	3.5
xiii)	Cabbage	-	5.6	-	-
xiv)	Cauliflower	-	6.3	-	-
xv)	Radish	-	2.5	-	-
xvi)	Tomatoes	-	8.3	-	-

Source: Field Survey, 1995

Table 13: Cropping Patterns by Categories of Household (per cent)

Particulars	Transformed Areas				Non-transformed Areas			
	Small	Medium	Large	All HHs	Small	Medium	Large	All HHs
Corn-Local	12.50	8.00	8.39	10.51	16.76	28.00	25.00	20.00
Corn-HYV	1.55	5.29	2.68	1.87	1.75	7.37	4.57	6.39
Paddy-Local	1.08	-	-	0.51	-	-	0.30	0.04
Paddy-HYV	1.41	-	9.73	3.69	-	-	-	-
Wheat	15.69	14.75	5.70	12.35	40.55	34.20	31.72	35.75
Barley	-	3.37	1.34	1.00	2.58	6.14	4.27	4.29
<i>Setaria italica</i>	-	-	-	-	0.12	-	0.62	0.22
Kidney bean	4.90	2.65	2.85	4.02	0.98	2.48	4.57	2.50
Oilseeds	-	-	1.01	0.31	0.25	-	0.30	0.10
Vegetables	2.84	5.18	1.18	2.79	-	-	-	-
Grainseeds	56.45	57.25	67.12	59.87	14.68	30.89	28.05	21.00
Potatoes	-	-	-	-	8.25	0.45	0.30	0.31
Total	100.00	100.00	100.00	100.00	100.00	100.00	100.00	100.00
Cropping Intensity	146.92	121.84	109.82	128.65	176.57	167.60	154.94	167.40

Source: Field Survey, 1995

Table 13: Average Yields of Major Crops by Categories of Household (MT/ha)

Particulars	Transformed Areas				Non-transformed Areas			
	Small	Medium	Large	All HHs	Small	Medium	Large	All HHs
Corn-black								
Local	2.3	2.0	2.0	2.1	1.2	1.4	1.3	1.3
HYV	2.7	2.1	2.3	2.6	1.9	1.9	2.3	2.0
Paddy								
Local	2.0	-	-	2.0	-	1.0	0.6	0.8
HYV	2.9	-	2.7	2.7	-	-	-	-
<i>Setaria italica</i>	-	-	-	-	0.3	-	0.2	0.2
Wheat HYV	2.4	2.2	1.8	2.3	0.9	1.1	1.2	1.7
Barley								
Local	-	-	1.1	1.1	1.2	1.0	0.05	1.0
HYV	1.6	1.3	-	1.5	-	-	-	-
Black gram	0.4	0.4	0.7	0.5	-	-	-	-
Kidney bean	0.5	0.5	0.6	0.5	0.5	0.3	0.6	0.7
Gram	-	-	-	-	0.2	-	-	0.2
Cabbage	5.6	-	-	5.6	-	-	-	-
Cauliflower	7.4	5.4	-	6.7	-	-	-	-
Radish	2.5	-	-	2.5	-	-	-	-
Peas	-	-	-	-	-	-	1.3	1.3
Tomatoes	8.0	8.4	-	8.3	-	-	5.0	5.0
Oilseeds	-	-	0.5	0.5	0.5	-	0.4	0.6
Potatoes	-	-	-	-	-	3.4	-	33.50
Chillies	-	-	-	-	-	0.5	-	5.00

Source: Field Survey, 1995

Table 12: Reasons for Non-Adoption of Modern Inputs by Households (Per Cent of Households)

Reasons	Transformed Areas				Non-transformed Areas			
	Small	Medium	Large	All HHs	Small	Medium	Large	All HHs
High cost of inputs	45	35	30	37	55	60	65	60
Lack of information	30	25	20	25	40	45	50	45
Lack of credit facilities	20	15	10	15	30	35	40	35
Lack of technical assistance	15	10	5	10	20	25	30	25
Lack of market facilities	10	5	5	10	15	20	25	20
Lack of risk-bearing facilities	5	5	5	5	10	15	20	15
Other	10	10	10	10	10	10	10	10

Table 14: Use of Modern Inputs by Categories of Household

Particulars	Transformed Areas				Non-transformed Areas			
	Small	Medium	Large	All HHs	Small	Medium	Large	All HHs
Area under HYV (per cent)								
Corn	43.05	50.79	21.74	41.15	11.20	21.25	15.46	18.58
Wheat	100.00	100.00	100.00	100.00	100.00	100.00	100.00	100.00
Paddy	58.33	-	100.00	88.10	-	-	-	-
Fertilizers (kg/ha)								
Corn								
N	59.15	42.66	47.55	53.10	26.89	27.45	32.73	28.50
P	1.96	0.00	0.00	1.15	0.00	1.47	6.19	2.01
K	0.00	0.00	0.00	0.00	0.00	0.09	3.09	1.00
% of HHs	65.96	87.50	57.14	67.74	55.00	75.00	85.71	63.49
Wheat								
N	54.69	46.59	45.46	51.29	19.99	23.91	19.53	21.16
P	2.50	-	0.00	1.53	1.25	8.55	11.53	6.30
K	0.00	-	0.00	0.00	0.61	4.27	5.77	3.15
% of HHs	68.09	87.50	71.43	70.97	45.00	56.25	71.43	65.08
All crops								
N	56.70	44.49	46.30	52.13	23.44	25.72	25.90	24.83
P	2.87	0.00	0.00	1.35	0.04	4.93	8.96	4.16
K	0.00	0.00	0.00	0.00	0.06	0.05	4.48	2.08
%age of HHs	67.02	87.50	64.29	69.35	46.25	65.63	78.57	56.35
Farmyard Manure (FYM) (Q/ha)								
Rabi crops	85.19	73.64	47.18	75.25	99.89	85.68	52.01	82.75
Kharif crops	114.14	90.08	50.47	90.12	101.40	96.70	77.96	94.09
All crops	111.80	82.42	49.25	83.18	100.65	911.30	64.54	88.43
Fruit crops								
N	51.49	38.18	85.17	56.01	51.98	73.68	97.98	77.82
P	28.41	32.96	119.33	50.74	10.04	72.98	39.92	43.60
K	67.99	57.33	150.30	84.49	5.02	45.61	39.92	32.92
FYM	62.37	65.12	92.55	70.08	73.33	65.50	75.31	72.72

Source: Field Survey, 1995

Table 15: Reasons for Non-Adoption of Modern Inputs by Categories of Household (Per Cent of Households)

Particulars	Transformed Areas				Non-transformed Areas			
	Marginal	Small	Large	All HHs	Marginal	Small	Large	All HHs
Per cent of Non-adopters	-	-	-	-	57.50	31.25	14.28	41.27
Lack of Finance	-	-	-	-	70.00	50.00	42.86	61.90
Lack of timely availability	0.02	-	-	0.16	47.50	43.75	42.80	46.03
Harmful to soils	-	-	-	-	10.00	43.75	14.28	19.05

Source: Field Survey, 1995

LIVELIHOOD OPTIONS — RANGE AND QUALITY

The range of livelihood options is the number of activities undertaken by a household, while their quality refers to the amount of income and employment generated by them. Given the agroclimatic conditions of a region, the number of livelihood options practised by a household depends on several factors; for instance the availability of infrastructural facilities, skills, assets, education, attitude towards risk, technical knowhow, and so on. In mountainous regions which are steeped in poverty, households engage in a variety of livelihood options to meet their basic needs for food, clothing, and shelter and to ensure survival. Many of these options are of a distress nature and yield an extremely low level of income and employment. Again, in these regions, the risk averse attitude of poor peasant households and their conservative attitudes in the choice of asset holding, which is a direct result of their poverty, hinders the adoption of land augmenting and land conserving innovations and leads to environmental degradation (Bifani 1992, pp 99 -120). The households in the above-mentioned situations do not readily switch over to high quality production options because of the high risk associated with these options; for example, they would not bring their entire land under high-value cash crops because of the very high risks associated with them. On the other hand, in mountainous regions that have undergone some degree of transformation, households adopt superior production options insofar as they are favourably endowed with resources, viz., skills and assets, to bear imponderable risks. The present chapter presents a historical perspective on how households have substituted, replaced, and added to their livelihood options in the process of economic transformation. It examines the effect of economic transformation on the number of livelihood options adopted by households and their quality in terms of income, employment, and intersectoral linkages.

Process of Option Enhancement in the Transformed Areas: A Historical Perspective

Prior to the Year 1930

Initially, crop production and livestock were the main livelihood options of the people. Cropping patterns were dominated by millet, such as foxtail millet, proso millet, finger millet, amaranth, grain chenopod, barley, wheat, paddy, corn, and black gram. Besides cows, large herds of sheep and goats were maintained. While millet, amaranth, and grain chenopod were the staple foods of the people, wheat, corn, and paddy were the cash crops. People also used to sell livestock products to meet their cash needs. They used to store surplus millet and other grains to meet emergencies (e.g., famine). The dependency on forests for fuelwood and fodder, particularly for grazing sheep and goats, was very high. Though apples

were introduced into the area by a British Captain, A.A. Lee, in 1870, at Bandrol, they were kept a closely-guarded secret and the local people and those working in the orchards as labourers were not allowed to take saplings away. Granny Smith, Winter, Macintosh, and Boldvin were the main varieties. The production technology was primitive. Since population pressure was low, mainly because of the high death rate, the pressure on land and other natural resources was marginal. Community participation in the management of natural resources, such as forests and water sources, was a common practice, and social sanctions were imposed on the use of these resources. Transportation was by mule and porters. The Kullu-Mandi road was built in the year 1925-26, and this facilitated the transportation of surplus production. There was endemic poverty in the area, and nearly 80 per cent of the families were food deficient; these families used to procure foodgrains from local landlords by pledging their services.

The Period from the Year 1930 to 1950

Cropping patterns continued to be dominated by foxtail millet, proso millet, finger millet, amaranth, barley, wheat, paddy, and corn. People also kept cows, bullocks, and large herds of sheep and goats. The introduction of potatoes in the year 1941-42 was the most important change. Potatoes became the main source of income besides wheat, paddy, corn, and animal products. The marketing of potatoes was facilitated by the opening of the road between Mandi and Kullu. Pathankot and Amritsar were the main marketing centres. The emergence of potatoes as a cash crop improved the local population's access to food. It shortened the hunger gap period and made a considerable contribution to poverty amelioration. Natural resource management continued to be community based. The pressure on land and other natural resources was low due to the low population. Land was still abundant, and this encouraged land-extensive cultivation.

Apple cultivation started to spread with large land holdings and through other leading farmers planting apple orchards. Nurseries were raised locally and apple saplings were supplied to the local people. During this period, people from the neighbouring district, Lahaul and Spiti, started migrating to the area. They purchased land and set up apple orchards. In 1945-46, the formation of small farmers' societies also encouraged apple cultivation.

The Period from the Year 1950 to 1965

The predominance of traditional crops (millet) in the cropping patterns began to decline; the area under these crops declined by almost 50 per cent towards the closing years of this period. These crops were being replaced by potatoes, wheat, corn, and paddy. Wheat, corn, and paddy began to lose their importance as cash crops. People also began to realise the limitations to the economic viability of livestock rearing, particularly in regard to sheep and goats. As a consequence of marginal and fallow lands also being brought under apple cultivation, the land for grazing was insufficient. Potatoes became the most important cash crop. While productivity was around 15 metric tonnes per hectare, net returns varied between IRs 1,500 to 2,000. The produce was transported by railways from Jogindernagar

to the distant markets of Madras, Bombay, and Calcutta. Nevertheless, potatoes lost importance as a cash crop towards the closing years of this period because of two reasons. First, the productivity of potatoes declined because of disease; second, the production of potatoes of a superior quality increased in the neighbouring district, Lahaul and Spiti. When these reached the market, it affected the demand for local potatoes.

The cultivation of apples received a big boost. New varieties like Red Royal and Royal Delicious, procured from Kashmir, were introduced. Cheap and subsidised foodgrains were provided to the people to encourage them to switch over to apple cultivation. The then Chief Minister, Sardar Partap Singh Kairon, visited the area and exhorted the people to produce apples because of their comparative advantages in the area and then to exchange them for foodgrains produced in the plains. The government took several measures to encourage apple cultivation such as the provision of massive subsidies on nursery plants, digging pits, preparing beds, and buying implements. In some cases, apple orchards were planted by forest officials on private land to motivate the local people to plant apples. An institutional infrastructure was created to promote apple cultivation as a cash crop. A separate department of horticulture was opened in 1960-61 and a district horticultural officer was appointed to coordinate its activities. A horticultural training centre was also set up in the same year and training camps were organised to train people to prepare nurseries and plant apple orchards. In addition, the implementation of land ceiling and tenancy legislations, under the directives of the central government, also helped the spread of apple cultivation. Insofar as the ceiling on orchards was much higher than the ceiling on agricultural land (1.5ha), big landlords (22.5ha) transformed their marginal and less fertile lands to apple orchards and thus succeeded in circumventing the ceiling laws. Also, since apple cultivation does not require much labour in the initial years, it also helped them to tide over labour shortages. The migration of people from the neighbouring district continued; they purchased land and planted apple orchards. Thus, the local landlords and migrated orchardists acted as catalytic agents in promoting apple cultivation. A fruit growers' association was formed in 1950-51. An attempt was also made by leading orchardists to start a fruit processing factory in 1956, for which the government sanctioned a grant of IRs 500,000. It, however, did not succeed because of a dispute over shares. The spread of apple cultivation also led to a mushrooming of sawmills to manufacture wooden boxes, particularly towards the end of the period. This also had adverse effects on the forest resources which had been underused for the past several decades.

The peoples' initiatives in the management of community resources, such as irrigation channels, forests, and so on, started declining, mainly because of government intervention in terms of launching community development programmes. The population also started increasing because of the availability of better medical facilities and an increase in incomes. This led to the sub-division of holdings and farm sizes started to decline. Land-extensive cultivation started giving way to land-intensive cultivation.

There was a near replacement of traditional millet and other crops with wheat, corn, and paddy, which was also facilitated the availability of high-yielding varieties of these crops. Wheat, corn, and paddy ceased to be cash crops and became the staple diet of the people, replacing traditional crops like millet. Potatoes were no longer cultivated. Peas were the main cash crop from 1965 to 1975, with peak production in the mid-seventies. Thereafter, their production declined drastically because of the spread of disease. The quality of livestock also started to change. The first jersey cow was introduced into the area in the year 1970-71 and dairy farming started emerging as a commercial activity. People also began to reduce the number of sheep and goats because of the declining availability of grazing lands.

Apples emerged as a one of the main cash crops. Their cultivation also spread among marginal and small farmers. Cultivation of apples spread further as a result of the distribution of surplus land among landless households and the availability of subsidised foodgrains through the public distribution system. Again, since the apple orchards planted by big landlords in the fifties started yielding bumper crops, marginal and small farmers were convinced of their economic viability. In many cases, small and marginal households were also compelled to convert their land into orchards, because birds from the surrounding orchards were destroying their cereal crops. Some developments on the marketing front, for instance the opening up of a short route to Delhi via Bilaspur and issuing of permits to truck operators to transport apples to Delhi, also promoted apple cultivation. Infrastructural facilities were further strengthened. The Horticultural Produce Marketing and Processing Corporation (HPMC) was set up with World Bank assistance in 1970-71 to provide a post-harvest infrastructure. This led to the construction of link roads and provision of grading, packing, and storage facilities. The Fruit Growers' Association was formed in 1977 to help fruit growers, particularly the small and marginal, to market their produce; for example, by arranging transport and paying compensation in the event of any accident or loss of produce. In short, the 1970s was the golden period for apple production. Because of the low incidence of diseases, the use of chemicals, insecticides, and pesticides was also negligible; only one to two applications used to be carried out. There were plenty of fauna and flora which facilitated cross pollination. The spread of apple cultivation helped to improve the local economy. Employment opportunities to the tune of 1,000 to 2,000 person days in plucking, transporting, packing, and so on were created every year. House construction activities gained momentum, leading to a rising demand for masons, carpenters, and unskilled labour. People started diversifying their economic activities to shops and businesses, tourism-related activities, apple marketing, and so on. In total, incomes increased substantially, leading to a significant mitigation of poverty.

Again, realising that apples can be grown even on marginal lands, people vied with one another to encroach government-owned and common lands. This led to a decrease in access to common property resources for the poor and disadvan-

tagged sections of society. Social values also changed. For example, previously there had been a stigma against buying foodgrains from the market, now it became fashionable and prestigious. Similarly, concern for maintaining common property resources declined.

The Period from the Year 1980 to 1995

The cultivation of traditional crops such as millet completely disappeared, and these were replaced by wheat, corn, and paddy. Livestock raising as an economic activity underwent qualitative changes; local animals were being replaced with improved varieties, and there was a complete switch over to stall feeding. Towards the close of this period, practically every household had an improved variety of cow. Consequently, dairy farming was fast emerging as an important commercial activity and a source of income; nearly 50 per cent of the households were selling milk. Vegetable cultivation also started to pick up. Though the area under vegetables was small, farmers were actively considering diversifying to off-season vegetable production for which there was a huge demand.

Apples continued to be the most important cash crop. Their cultivation spread further, and small and marginal farmers brought more than 50 per cent of their land under apple orchards. Production was, however, affected by numerous diseases. An attack of scab in the early 1980s affected apple production adversely. Other diseases, e.g., canker, also appeared. To control diseases, growers resorted to excessive use of chemicals, insecticides, and pesticides; as many as six to seven applications were carried out in comparison to one to two in the seventies. The excessive use of chemicals destroyed honeybees and other useful insects that facilitate cross pollination. The spread of diseases, coupled with weather fluctuations, particularly at the time of fruit setting, caused a substantial reduction in apple production which, in turn, had an adverse effect on the local economy. As a result, the local people began to actively consider diversifying to other activities such as floriculture, mushroom farming, fisheries, off-season vegetables, and dairy farming in order to reduce their excessive dependency on apple cultivation.

During this period, the State government took certain initiatives. It announced support prices to protect growers from price fluctuations. Realising that the use of wooden boxes for packing apples, along with the policy of allotting timber to the sawmills, was causing damage to the forests, cardboard boxes were introduced as an alternative and the practice of supplying timber from the forest was stopped. This obliged fruit growers to look for alternatives. Consequently, in the mid-nineties, out of the total boxes used, 20 to 30 per cent were cardboard boxes, 20 to 25 per cent were recycled boxes from Delhi, and the rest were manufactured from Eucalyptus timber imported from the neighbouring states of Punjab and Hariyana. More recently, realising the harmful effects from the excessive use of chemical fertilizers, people have started using more farmyard manure (FYM) and compost. There is also a visible, emerging shift to other alternative cash crops such as peas, flowers, and so on.

Range of Livelihood Options

The empirical evidence available from the study areas reveals no significant relationship between the range of livelihood options adopted by households in the transformed and non-transformed areas. As shown in Table 16, nearly four-fifths of the total households in both areas are engaged in three to four livelihood options. Nonetheless, the data indicate a significantly higher percentage of households (17.46%) adopting five to six livelihood options in the non-transformed areas compared to 4.84 per cent in transformed areas. No household, however, adopted more than five to six options. The patterns were almost similar with regard to different categories of household in both types of area, except that in the non-transformed areas more than one-third of the medium and more than one-fourth of the large households adopted five to six livelihood options compared to 4.26 per cent of the small farmers adopting options in the range of five to six (Tables 17 and 18). Furthermore, while there was no relationship between the range of livelihood options adopted by the households and the per capita and household income in the transformed areas, a positive relationship existed in the case of non-transformed areas, particularly regarding household income for all categories of household.

Table 16: Range of Livelihood Options: All Households

Range	Transformed Areas			Non-transformed Areas		
	% age of HH	HH income	Per capita income	% age of HH	HH income	Per capita income
Up to 2	9.68	82498	13026	3.17	8309	1846
3-4	85.48	67423	9684	79.37	33574	5134
3-6	4.84	88135	15553	17.46	48089	5750
All Households	100.00	69884	10219	100.00	35305	5197

Source: Field Survey, 1995

Note: Household and per capita incomes are net income figures in Indian Rupees (1 US\$ = IRs 35.00)

Table 17: Range of Livelihood Options by Categories of Household: Transformed Areas

Range	Small			Medium			Large		
	%age of HH	HH income	Per capita income	%age of HH	HH income	Per capita income	%age of HH	HH income	Per capita income
Up to 2	8.51	58842	8717	12.50	67599	16900	14.29	192021	27432
3-4	87.23	58186	9140	75.00	80803	8506	85.71	117161	13784
5-6	4.26	101093	18381	12.50	76830	10370	-	-	-
All Households	100.00	60068	9442	100.00	76831	9174	100.00	127855	15431

Source: Field Survey, 1995

Note: Household and per capita incomes are net income figures in Indian Rupees (1 US\$ = IRs 35.00)

Table 18: Range of Livelihood Options by Categories of Household: Non-transformed Areas

Range	Small			Medium			Large		
	%age of HH	HH income	Per capita income	%age of HH	HH income	Per capita income	%age of HH	HH income	Per capita income
Up to 2	2.50	9585	1917	6.25	7032	1758	-	-	-
3-4	90.00	23897	4136	56.25	46669	5316	71.43	69672	9959
5-6	7.50	24616	3692	37.50	51540	6443	28.57	71938	6078
All Households	100.00	23593	4050	100.00	46019	5629	100.00	77748	8504

Source: Field Survey, 1995

Note: Household and per capita incomes are net income figures in Indian Rupees (1 US\$ = IRs 35.00)

The configuration of livelihood options in different ranges and their contribution to total household income in the transformed and non-transformed areas have been shown in Tables 19 and 20 respectively. A few comments are in order. First, in the transformed areas, while households practising up to two options had adopted fruit crops, livestock, and service, more than two-thirds of their total income was contributed by fruit crops alone. The households practising three to four and five to six options had adopted practically all the options in varying combinations. Regarding the contribution of different options to income, fruit crops and services accounted for a large percentage of the household income. Second, in the non-transformed areas, the households practising two options had adopted crop production, livestock, and agricultural labour in varying combinations, whereas three-fourths of the household income came from crop production and agricultural labour. Among those adopting three to four and five to six options, all the important options were being adopted in varying combinations, but about half of the household income came from services and fruit crops. Third, among different categories of household in transformed areas, fruit crops accounted for more than fifty per cent of the total household income, particularly in the case of medium and large households (Tables 21 and 22). Fourth, in non-transformed areas, the small and medium households (Tables 23 and 24) which adopted two livelihood options were engaged in crop production, livestock, and agricultural labour, and a large part of their income was being contributed by agricultural labour in the case of small households and crop production in the case of medium households. Insofar as large households were concerned (Table 25), all households who adopted more than two options were engaged in all the options except collection of wild products and weaving. However, in the case of those who adopted three to four options, a large share of the income came from fruit crops and service, while, in the case of others, crop production followed by fruit crops and livestock provided most to the income.

A variety of factors, both at the household level and community level, determines the number of livelihood options adopted by a household. At the house-

Table 19: Range-wise Livelihood Options and Their Contribution to Total Household Income, All Households: Transformed Areas

S. No.	Livelihood Options/ Range	% of Households Involved			% share of Income		
		Up to 2	3-4	5-6	Up to 2	3-4	5-6
1.	Crop Production	-	94.34	100.00	-	6.92	3.70
2.	Vegetable Production	-	15.09	100.00	-	1.06	7.75
3.	Livestock	66.67	90.57	100.00	13.55	18.29	22.43
4.	Fruit Crops	100.00	100.00	100.00	63.74	43.23	22.43
5.	Weaving	-	7.75	33.33	-	0.61	0.38
6.	Agricultural Labour	-	11.32	-	-	1.80	-
7.	Service	33.33	28.30	66.67	22.71	25.40	46.90
8.	Business/Shop	-	3.77	-	-	2.69	-

Source: Field Survey, 1995

Note: Livestock include dairy animals, sheep, goat, and poultry

Table 20: Range-wise Livelihood Options and Their Contribution to Household Income, all Households: Non-transformed Areas

S. No	Livelihood Options/ Range	% of Households Involved			% share of Income		
		Up to 2	3 - 4	5 - 6	Up to 2	3 - 4	5 - 6
1.	Crop Production	100.00	100.00	100.00	45.60	15.09	19.55
2.	Livestock	50.00	90.00	100.00	16.49	12.85	14.05
3.	Fruit Crops	-	70.00	100.00	-	19.15	22.30
4.	Weaving	-	6.00	27.27	-	0.54	2.10
5.	Agricultural Labour	50.00	40.00	27.27	37.91	7.62	6.63
6.	Non-agricultural Labour	-	18.00	18.18	-	8.13	5.45
7.	Wild Products	-	10.00	36.36	-	0.54	1.04
8.	Services	-	30.00	63.64	-	30.09	23.03
9.	Business/Shop	-	12.00	36.36	-	5.99	4.76

Source: Field Survey, 1995

Table 21: Range-wise Livelihood Options and Their Contribution to Total Household Income, Small Households: Transformed Areas

S. No.	Livelihood Options/Range	% of Households Involved			% of Income		
		Up to 2	3 - 4	5 - 6	Up to 2	3 - 4	5 - 6
1.		Up to 2	3 - 4	5 - 6	Up to 2	3 - 4	5 - 6
2.	Crop Production	-	92.68	100.00	-	5.55	1.47
3.	Vegetable Production	-	12.20	100.00	-	0.50	6.50
4.	Livestock	50.00	87.80	100.00	6.51	18.12	20.85
5.	Fruit Crops	100.00	100.00	100.00	45.73	39.04	9.85
6.	Weaving	-	4.88	-	-	0.84	-
7.	Agricultural Labour	-	14.63	-	-	2.69	-
8.	Service	50.00	29.27	100.00	47.76	31.25	61.33
9.	Business /Shop	-	2.44	-	-	2.01	-

Source: Field Survey, 1995

Table 22: Range-wise Livelihood Options and Their Contribution to Total Household Income, Medium Households: Transformed Areas

S. No.	Livelihood Options/ Range	% of Households Involved			% of Income		
		Up to 2	3-4	5-6	Up to 2	3-4	5-6
1.	Crop Production	-	100.00	100.00	-	8.48	10.93
2.	Vegetables	-	33.33	100.00	-	3.45	11.81
3.	Livestock	100.00	100.00	100.00	19.84	18.06	12.32
4.	Fruit Crops	100.00	100.00	100.00	80.16	48.97	63.33
5.	Weaving	-	-	100.00	-	-	1.61
6.	Agricultural Labour	-	-	-	-	-	-
7.	Service	-	16.67	-	-	11.14	-
8.	Business /Shop	-	16.67	-	-	9.90	-

Source: Field Survey, 1995

Table 23: Range-wise Livelihood Options and Their Contribution to Total Household Income, Large Households: Transformed Areas

S. No	Livelihood Options/ Range	% of Households Involved			% of Income		
		Up to 2	3 - 4	5 - 6	Up to 2	3 - 4	5 - 6
1.	Crop Production	-	100.00	-	-	10.51	-
2.	Vegetable Production	-	16.67	-	-	1.31	-
3.	Livestock	100.00	100.00	-	19.96	19.03	-
4.	Fruit Crops	100.00	100.00	-	80.04	53.15	-
5.	Weaving	-	16.67	-	-	0.28	-
6.	Agricultural Labour	-	-	-	-	-	-
7.	Service	-	23.33	-	-	15.36	-
8.	Business/Shop	-	-	-	-	-	-

Source: Field Survey, 1995

Table 24: Range-wise Livelihood Options and Their Contribution to Total Household Income, Small Households: Non-transformed Areas

S. No	Livelihood Options/ Range	% of Households Involved			% of Income		
		Up to 2	3 - 4	5 - 6	Up to 2	3 - 4	5 - 6
1.	Crop Production	100.00	100.00	100.00	34.277	14.11	16.54
2.	Livestock	-	86.11	100.00	-	12.84	16.97
3.	Fruit Crops	-	63.89	100.00	-	10.69	22.00
4.	Weaving	-	-	-	-	-	-
5.	Agricultural Labour	100.00	50.00	66.67	65.73	13.56	9.14
6.	Non-agricultural Labour	-	16.67	33.33	-	10.28	17.06
7.	Wild Products	-	13.89	66.67	-	1.05	3.39
8.	Service	-	27.78	33.33	-	26.43	12.19
9.	Business/Shop	-	11.11	33.33	-	11.04	2.71

Source: Field Survey, 1995

Note: Livestock include dairy animals, sheep, goat, and poultry

Table 25: Range-wise Livelihood Options and Their Contribution to Total Household Income, Medium Households: Non-transformed Areas

S. No	Livelihood Options/Range	% of Households Involved			% of Income		
		Up to 2	3 - 4	5 - 6	Up to 2	3 - 4	5 - 6
1.	Crop Production	100.00	100.00	100.00	61.03	15.94	20.19
2.	Livestock	100.00	100.00	100.00	38.96	9.34	11.33
3.	Fruit Crops	-	77.78	100.00	-	20.89	18.94
4.	Weaving	-	11.11	16.67	-	1.07	0.65
5.	Agricultural Labour	-	22.22	16.67	-	2.71	10.86
6.	Non-agricultural Labour	-	33.33	16.67	-	11.43	5.24
7.	Wild Products	-	-	33.33	-	-	0.97
8.	Service	-	33.33	83.33	-	37.57	31.43
9.	Business/Shop	-	11.11	16.67	-	1.05	0.37

Source: Field Survey, 1995

Note: Livestock include dairy animals, sheep, goat, and poultry

hold level, factors such as availability of land, labour, assets, skills, availability of market facilities, and so on play an important role in determining the number of options. For the non-transformed areas, the zero order correlation matrix, presented in Table 26, shows a positive and significant relationship between the number of household options and factors such as total income, land owned, value of livestock, total assets, family size, and number of educated members in the family. On the other hand, in the transformed areas, (Table 27) there is a positive but insignificant relationship between the number of options and factors mentioned above. In these areas, factors such as the availability of markets for high-value cash crops, perhaps, play a more important role in motivating the households to undertake additional production options.

To conclude, micro data do not support the hypothesis that households in the non-transformed areas, that are poorer in terms of asset holdings and skills, adopt a higher number of livelihood options than their counterparts in the transformed areas. Regarding the relationship between the range of livelihood options in an average household and the per capita income, while there is no systematic relationship in the transformed areas, a positive relationship exists in the non-transformed areas.

Livelihood Options: Employment, Income and Linkages

The contribution of different livelihood options to employment for all categories of households, both in the transformed and non-transformed areas, has been shown in Table 28. Agriculture, defined to include crop production, fruit crops, and livestock, accounts for nearly 70 per cent of the total household employment in the transformed areas. Among the non-agricultural sources of employment, service is the most important. Whereas, in the non-transformed areas, the agricultural sector accounts for two-thirds of the total employment; service and non-

Table 26: Range-wise Livelihood Options and Their Contribution to Total Household Income, Large Households: Non-transformed Areas

S. No	Livelihood Options/ Range	% of Households Involved			% of Income		
		Up to 2	3 - 4	5 - 6	Up to 2	3 - 4	5 - 6
1.	Crop Production	-	100.00	100.00	-	16.28	29.60
2.	Livestock	-	100.00	100.00	-	16.60	18.34
3.	Fruit Crops	-	100.00	100.00	-	35.57	19.71
4.	Weaving	-	40.00	100.00	-	1.13	6.58
5.	Agricultural Labour	-	-	-	-	-	-
6.	Non-agricultural Labour	-	-	-	-	-	-
7.	Wild Products	-	-	-	-	-	-
8.	Service	-	40.00	50.00	-	30.12	10.69
9.	Business/Shop	-	20.00	100.00	-	0.30	15.08

Source: Field Survey, 1995

Note: Livestock include dairy animals, sheep, goat, and poultry

Table 27: Determinants of Livelihood Options, Non-transformed Areas: Zero Order Correlation Matrix

Variables	X ₁	X ₂	X ₃	X ₄	X ₅	X ₆	X ₇	X ₈	X ₉	X ₁₀
X ₁	1.0000									
X ₂	0.5164*	1.0000								
X ₃	0.1519*	0.3914*	1.0000							
X ₄	0.2241	0.5332*	0.2810*	1.0000						
X ₅	0.3938*	0.6422*	0.2910*	0.7948*	1.0000					
X ₆	0.4842*	0.5828*	0.3251*	0.3276*	0.4069*	1.0000				
X ₇	-0.0699	0.0143*	-0.0044*	0.0695*	0.1005*	0.0404*	1.0000			
X ₈	0.0913*	0.3391*	0.3366*	0.6538*	0.3287*	0.3684*	0.0384*	1.0000		
X ₉	0.3467*	0.6511*	0.3687*	0.5647*	0.6433*	0.5210*	0.1938*	0.5320*	1.0000	
X ₁₀	0.4420*	0.5890*	0.4886*	0.5213*	0.4613*	0.6608*	0.1034	0.5034*	0.5133*	1.0000

Source: Computed from Field Data

Note: (i) significant at a 5 per cent level of probability, (ii) X₁ = Non-farm income; X₂ = Total household income (IRs); X₃ = Number of options; X₄ = Land owned (Bighas, 12.5 Bighas = one hectare); X₅ = Land under orchards; X₆ = Family size; X₇ = Livestock (IRs) X₈ = Total assets; X₉ = Number of educated members in a family; X₁₀ = Education of the head of the family

agricultural labour, contributing one-fifth of the total employment, are the main non-farm sources of employment. The pattern was almost similar among different categories of household in both the transformed and non-transformed areas. For example, in the case of small households, livestock were an important source of employment followed by fruit crops in the transformed areas and crop production in the non-transformed areas (Table 29). Regarding medium households (Table 30), the pattern was different with fruit crops, and these accounted for

Table 28: Determinants of Livelihood Options, Transformed Areas: Zero Order Correlation Matrix

Variables	X ₁	X ₂	X ₃	X ₄	X ₅	X ₆	X ₇	X ₈	X ₉	X ₁₀
X ₁	1.0000									
X ₂	0.5662*	1.0000								
X ₃	0.3399*	0.2858 *	1.0000							
X ₄	- 0.1533	0.5175 *	0.1010	1.0000						
X ₅	- 0.1265	0.5941 *	0.0282	0.9090*	1.0000					
X ₆	0.2965 *	0.3249*	0.1527	0.1174	0.1211	1.0000				
X ₇	- 0.1015	0.1408*	0.1306	0.1362*	0.1501*	- 0.3267	1.0000			
X ₈	- 0.1034	0.4018*	0.0990	0.4702*	0.4895*	0.2290	-0.0509*	1.0000		
X ₉	0.0739*	0.5355*	0.0026	0.6069	0.5644	0.1014*	0.1282*	0.2894	1.0000	
X ₁₀	-0.2478*	0.3172*	0.0989	0.1379	0.1701	0.8936*	0.2021	0.3051*	0.1963	1.0000

Source: Computed from Field Data

Note: (i) significant at a 5 per cent level of probability, (ii) X₁ = Non-farm income; X₂ = Total household income (IRs); X₃ = Number of options; X₄ = Land owned (Bighas, 12.5 Bighas = one hectare); X₅ = Land under orchards; X₆ = Family size; X₇ = Livestock (IRs) X₈ = Total assets; X₉ = Number of educated members in a family; X₁₀ = Education of the head of the family

Table 29: Livelihood Options and Their Quality (Employment): All Households (Person days)

S. No.	Livelihood Options	Transformed Areas		Non-transformed Areas	
		Per Worker	Per Household	Per Worker	Per Household
1.	Crop Production	19 (5.54)	41 (5.50)	69 (17.00)	143 (16.88)
2.	Vegetable Production	3 (0.87)	6 (0.82)	-	-
3.	Livestock	119 (34.70)	250 (34.01)	127 (31.28)	251 (29.63)
4.	Fruit Crops	99 (28.87)	212 (28.84)	39 (9.60)	83 (9.80)
5.	Wild Products	-	-	5 (1.23)	10 (1.18)
6.	Weaving	3 (0.87)	5 (0.68)	3 (0.74)	6 (0.71)
7.	Agricultural Labour	15 (4.18)	32 (4.49)	45 (11.08)	116 (13.70)
8.	Non-agricultural Labour	-	-	43 (10.59)	76 (8.97)
9.	Services	79 (23.03)	173 (23.54)	53 (13.06)	115 (13.58)
10.	Business/Shop	7 (2.04)	15 (2.04)	22 (5.42)	47 (5.55)
	All Options	343 (100.00)	735 (100.00)	406 (100.00)	847 (100.00)

Source: Field Survey, 1995

Note: Figures in parentheses are percentages

more than half of the person days in the transformed areas and fruit crops followed by services and crop production in the non-transformed areas. The fruit crop was, however, the most important source of employment for large households, particularly in the transformed areas (Table 31). It, however, needs to be underlined that the amount of employment in various production options, particularly in the backward regions, does not reflect their quality. As is well known, the households in these areas are disguisedly unemployed; despite the fact that they remain fully employed throughout the year, they are hardly able to make both ends meet, let alone make a decent living.

In the case of household income (Table 32), agriculture-related activities contribute two-thirds of the total income, fruit production (mainly apples) alone accounts for more than two-fifths of the income in the transformed areas. In the non-transformed areas, the share of agriculture-related activities is nearly one-half, with fruit production contributing nearly one-fifth, crop production, 16 per cent, and livestock, 13 per cent. Among the non-farm activities, service contributes more than one-fourth, followed by business and non-agricultural labour. Neverthe-

Table 30: Livelihood Options and Their Quality (Employment): Small Households (Person days)

S. No.	Livelihood Options	Transformed Areas		Non-transformed Areas	
		Per Worker	Per HH	Per Worker	Per HH
1.	Crop Production	15 (4.32)	29 (4.24)	50 (12.99)	88 (12.55)
2.	Vegetable Production	1 (0.29)	3 (0.44)	-	-
3.	Livestock	116 (33.43)	223 (32.60)	140 (36.36)	231 (32.96)
4.	Fruit Crops	87 (25.08)	172 (25.15)	22 (5.71)	38 (5.42)
5.	Wild Products	-	-	8 (2.08)	12 (1.71)
6.	Weaving	3 (0.86)	6 (0.88)	-	-
7.	Agricultural Labour	21 (6.05)	42 (6.14)	60 (15.58)	122 (17.40)
8.	Non-agricultural Labour	-	-	56 (14.55)	95 (13.55)
9.	Services	99 (28.53)	199 (29.09)	31 (8.05)	59 (8.42)
10.	Business/Shop	5 (1.44)	10 (1.46)	18 (4.68)	56 (7.99)
	All Options	347 (100.00)	684 (100.00)	385 (100.00)	701 (100.00)

Source: Field Survey, 1995

Note: Figures in parentheses are percentages

Table 31: Livelihood Options and Their Quality (Employment): Medium Households (Person days)

S. No.	Livelihood Options	Transformed Areas		Non-transformed Areas	
		Per Worker	Per HH	Per Worker	Per HH
1.	Crop Production	23 (9.24)	78 (9.46)	67 (16.96)	177 (17.07)
2.	Vegetable Production	8 (3.21)	19 (2.31)	-	-
3.	Livestock	143 (57.43)	348 (42.23)	127 (32.18)	310 (29.88)
4.	Fruit Crops	26 (10.44)	263 (31.92)	38 9.62	90 (8.68)
5.	Wild Products	-	-	3 (0.76)	9 (0.87)
6.	Weaving	1 (0.40)	2 (0.24)	4 (1.01)	11 (1.06)
7.	Agricultural Labour	-	-	40 (10.13)	112 (10.80)
8.	Non-agricultural Labour	-	-	35 (8.86)	99 (9.55)
9.	Services	24 (9.64)	57 (6.92)	77 (19.49)	217 (20.93)
10.	Business/Shop	24 (9.64)	57 (6.92)	4 (1.01)	12 (1.16)
	All Options	249 (100.00)	824 (100.00)	395 (100.00)	1037 (100.00)

Source: Field Survey, 1995

Note: Figures in parentheses are percentages

less, taking into account the amount of household income without taking cognisance of the amount of employment does not truly reflect the quality of livelihood options. Therefore, to measure the quality of different livelihood options, both employment and income have to be considered. One such measurement is the per worker, per day earnings from different options. Guided by the per worker, per day earnings, the quality of livelihood options adopted by households in transformed areas is far superior to the quality of options in the non-transformed areas. Among various options, fruit crops, vegetable production, businesses, and shops are of a very high quality. It needs to be mentioned that vegetable production, though contributing very little towards total household income and employment, is of very high quality, indicating a potential and scope for diversification. On the other hand, in the non-transformed areas, daily earnings from various options are extremely low, reflecting their inferior quality; a striking example is that of livestock activities which account for more than one-fourth of the total employment, whereas per worker, per day earnings are as low as IRs 18. As per this criterion, livelihood options, such as collection and sale of wild products, weaving, and agricultural and non-agricultural labour, are of a distress nature, undertaken primarily with the survival motive in mind, and are characteristic of

Table 32: Livelihood Options and Their Quality (Employment): Large Households (Person days)

S. No.	Livelihood Options	Transformed Areas		Non-transformed Areas	
		Per Worker	Per Household	Per Worker	Per Household
1.	Crop Production	32 (9.82)	98 (9.90)	146 (30.67)	374 (30.89)
2.	Vegetable Production	5 (1.53)	15 (1.52)	-	-
3.	Livestock	112 (34.36)	331 (33.43)	84 (17.65)	230 (18.99)
4.	Fruit Crops	135 (41.40)	412 (41.62)	167 (35.09)	302 (24.94)
5.	Wild Products	-	-	-	-
6.	Weaving	1 (0.31)	4 (0.40)	9 (1.89)	25 (2.06)
7.	Agricultural Labour	-	-	-	-
8.	Non-agricultural Labour	-	-	-	-
9.	Services	41 (12.58)	130 (13.13)	38 (7.98)	202 (16.88)
10.	Business/Shop	-	-	32 (6.72)	78 (6.44)
	All Options	326 (100.00)	990 (100.00)	476 (100.00)	1211 (100.00)

Source: Field Survey, 1995

Note: Figures in parentheses are percentages

options taken by hard-working peasants. A more or less similar pattern is in evidence among different categories of household; the notable exception is higher per worker, per day earnings from crop production compared to vegetable production in the case of large households and an equal amount of per day earnings from vegetable production and fruit crops in the case of medium households in transformed areas (Tables 33 through 36).

Numerous factors contribute to the extremely low productivity of different livelihood options in the non-transformed areas. Some of these factors, as mentioned earlier, are poor quality of livestock breed, low use of modern inputs such as chemical fertilizers and high yielding varieties, lack of infrastructural facilities, and low level of education. One of the most important factors, however, is that of inaccessibility, e.g., the lack of roads. As may be seen from Table 37, while there is no significant difference in the percentage contribution of different cost components of a 20kg box of apples to total production and marketing costs, the transport costs up to the road head alone account for as much as 23 per cent in the non-transformed areas compared to a low three per cent in the transformed areas. Therefore, the provision of all-weather roads is essential not only to improve the quality of livelihood options, but also, in the ultimate analysis, to promote sustainable development.

Table 33: Livelihood Options and Their quality (income): All Households (IRs per household)

S. No.	Livelihood Options	Transformed Areas		Non-transformed Areas	
		Per Household	Per Worker Per Day	Per Household	Per Worker Per Day
1.	Crop Production	4148 (5.93) [1197]	101	5781 (16.37) [5516]	40
2.	Vegetable Production	940 (1.34) [26721]	157	-	-
3.	Livestock	12428 (17.78)	49	4648 (13.17)	18
4.	Fruit Crops	30962 (44.3) [41080]	146	6975 (19.76) [23598]	84
5.	Wild Products	-	-	230 (0.65)	23
6.	Weaving	371 (0.53)	74	327 (0.93)	54
7.	Agricultural Labour	1035 (1.48)	33	2786 (7.89)	24
8.	Non-agricultural Labour	-	-	2609 (7.39)	34
9.	Services	18452 (26.40)	106	9952 (28.19)	86
10.	Business/Shop	1548 (2.22)	103	1997 (5.65)	42
	All Options	69884 (100.00)	95	35305 (100.00)	42

Source: Field Survey, 1995

- Note: 1. Figures in parentheses are percentages
2. Figures in square brackets are net income per hectare

To conclude, while there is no significant difference in the range of livelihood options adopted by the households in both areas, the evidence at our disposal lends credence to the belief that, in the transformed areas, multiple options are undertaken with a view to maximising net returns and internalising the external economies; for example, households keep animals to use the fodder available in the orchards. On the other hand, in the transformed areas, households resort to multiple options with a survival motive and to minimise the risk and stabilise their household incomes. The evidence at hand also supports the hypothesis that the availability of basic infrastructural facilities, for instance roads, plays an important role in sustaining and improving upon the quality of livelihood options.

Backward and Forward Linkages

The extent and nature of the linkages associated with different livelihood options are yet other important indicators of their quality. A livelihood option that generates a variety of backward-forward linkages is considered superior and of high quality. In fact, the essence of the argument behind the strategy of unbalanced

Table 34: Livelihood Options and Their Quality (Income): Small Households (IRs per Household)

S. No.	Livelihood Options	Transformed Areas		Non-transformed Areas	
		Per Household	Per Worker Per Day	Per Household	Per Worker Per Day
1.	Crop Production	2880 (4.79) [9753]	99	3423 (14.51) [5182]	39
2.	Vegetable Production	533 (0.89) [22755]	177	-	-
3.	Livestock	10421 (17.35)	46	3074 (13.03)	13
4.	Fruit Crops	22527 (37.50) [48391]	131	2706 (11.47) [23126]	71
5.	Wild Products	-	-	-	24
6.	Weaving	426 (0.71)	71	2825 (11.97)	-
7.	Agricultural Labour	1366 (2.27)	33	2942 (12.47)	23
8.	Non-agricultural Labour	-	-	5910 (25.05)	31
9.	Services	20894 (34.79)	105	2425 (10.28)	100
10.	Business/Shop	1021 (1.70)	102	2425 (10.28)	43
	All Options	60068 (100.00)	88	23593 (100.00)	34

Source: Field Survey, 1995

Note: 1. Figures in parentheses are percentages

2. Figures in square brackets are net income per hectare

development is to identify and promote key activities/sectors having the potential for generating maximum linkages.

As is well known, in poor agrarian economies, including mountainous regions, there are strong linkages between various economic activities in general and crop production and livestock, in particular; the former supplies fodder, both green and dry, in terms of crop residue, by-products, weeds, grasses, etc, and the latter farmyard manure and animal power to carry on diverse agricultural operations. It, however, needs to be underlined that, in such economies, linkages, though very strong, barely sustain the system at a low level of productivity without resulting in any improvement in either activity. In essence, a production option which has a potential for strong and high quality linkages between farm and non-farm sectors helps not only to sustain closely related activities but also to improve upon their productivity. In brief, the mere existence of linkages between different options neither indicates their quality nor offers any insight into their sustainability nuances. In the final analysis, what matters really is the nature and

Table 35: Livelihood Options and Their Quality (Income): Medium Households (IRs Per Household)

S. No.	Livelihood Options	Transformed Areas		Non-transformed Areas	
		Per Household	Per Worker Per Day	Per Households	Per Worker Per Day
1.	Crop Production	5992 (7.80) [144381]	77	8366 (18.16) [5561]	47
2.	Vegetable Production	3005 (3.91) [30050]	158	-	-
3.	Livestock	13582 (17.68)	39	4814 (10.46)	16
4.	Fruit Crops	41376 (53.85) [37445]	157	9143 (19.87) [22857]	102
5.	Wild Products	-	-	188	21
6.	Weaving	125 (0.16)	63	406 (0.88)	37
7.	Agricultural Labour	-	-	2786 (6.05)	25
8.	Non-agricultural Labour	-	-	4039 (8.78)	41
9.	Service	6750 (8.79)	118	15938 (34.63)	73
10.	Business/Shop	6000 (7.81)	105	350	29
	All Options	76830 (100.00)	93	46019 (100.00)	44

Source: Field Survey, 1995

- Note: 1. Figures in parentheses are percentages
2. Figures in square brackets are net income per hectare

quality of linkages and not merely their existence and magnitude. In this context, the evidence at our disposal suggests that, in the transformed areas, the introduction of high-value cash crops (mainly apples), a dominant production option contributing as much as 44 per cent of the total household income, is not only in conformity with mountain specificities and ecology but has also generated backward-forward linkages of a very high quality as well. Some of these linkages are discussed below.

Backward Linkages

The expansion in areas under fruit crops and an increase in apple production have encouraged business and shop activities. For example, to cater to the needs of fruit growers, many shops have begun to supply chemical and other inputs, e.g., tree spraying oil; numerous private nurseries have also begun to meet the growing needs for apple saplings. Some self-help institutions, such as the Fruit Growers' Association and cooperatives, have also been formed to ensure a timely

Table 36: Livelihood Options and Their Quality (Income): Large Households (IRs Per Household)

S. No.	Livelihood Options	Transformed Areas		Non-transformed Areas	
		Per Household	Per Worker Per Day	Per Household	Per Worker Per Day
1.	Crop Production	10549 (8.25) [172533]	108	13374 (17.20) [5088]	36
2.	Vegetable Production	1311 (1.03) [32786]	87	-	-
3.	Livestock	24588 (19.23)	74	13265 (17.06)	58
4.	Fruit Crops	75692 (59.20) [33115]	184	26410 (33.97) [24848]	87
5.	Wild Products	-	-	-	-
6.	Weaving	286 (0.22)	72	2014 (2.59)	81
7.	Agricultural Labour	-	-	-	-
8.	Non-agricultural Labour	-	-	-	-
9.	Services	15429 (12.07)	119	19371 (24.92)	96
10.	Business/Shop	-	-	3314 (4.26)	42
	All Options	127855 (100.00)	129	77748 (100.00)	64

Source: Field Survey, 1995

supply of post-harvest facilities like packing boxes, transportation, and so on. Apple cultivation has also given a big boost to the local cottage industry, locally known as *kilta*, for which the demand has increased substantially. Also, many sawmills have been opened to manufacture packing boxes. And, despite the fact that many of these have been closed due to non-availability of timber from the local forests, many still manufacture boxes of timber imported from the neighbouring states of Punjab and Hariyana where agroforestry has been taken up on a large scale to supply timber to fruit growers. Thus, the spread of apple cultivation has helped to harness comparative advantages across different regions. In addition, it has also led to expansion in link roads, setting up of cold storage facilities, opening up of banks, government department offices, and so on.

Forward Linkages

The most important effect falling under forward linkages of the spread of apple cultivation has been the increasing house construction leading to a surge in the demand for carpenters, masons, and unskilled labour, apart from the demand for cement, iron, steel, and bricks. This has led to a multiplier effect on the wages and employment of the local labour force, both skilled and unskilled. The increased

Table 37: Costs and Returns from Apple Cultivation: Per Box of 20kg

S. No.	Cost Components	Transformed Areas (Farmers)				Non-transformed Areas (Farmers)			
		Small	Medium	Large	All	Small	Medium	Large	All
i	Fertilizers	4.96 (6.94)	5.26 (7.02)	7.36 (11.08)	5.94 (8.48)	3.76 (5.96)	5.86 (8.15)	3.63 (5.43)	4.26 (6.29)
ii	Hired Labour	6.00 (8.40)	9.39 (12.54)	6.06 (9.12)	6.68 (9.54)	2.20 (3.49)	3.80 (5.28)	5.28 (7.90)	4.44 (6.52)
iii	Spraying	15.56 (21.79)	15.86 (21.15)	8.77 (13.20)	13.02 (18.59)	2.90 (4.61)	7.11 (9.88)	3.99 (5.97)	4.70 (6.90)
iv	FYM	2.40 (3.36)	2.40 (3.20)	2.25 (3.39)	2.40 (3.43)	2.44 (3.86)	3.40 (4.73)	2.15 (3.22)	2.94 (4.32)
v	Packing material (box+nails+paper)	15.00 (21.00)	15.00 (20.03)	15.00 (22.58)	15.00 (21.41)	16.00 (25.37)	16.00 (22.24)	16.00 (23.95)	16.00 (23.49)
vi	Transportation cost up to road head	2.00 (2.80)	2.00 (2.68)	2.00 (3.00)	2.00 (2.86)	16.00 (25.37)	16.00 (22.24)	16.00 (23.95)	16.00 (23.49)
vii	Transportation to Delhi market	15.50 (21.70)	15.00 (20.03)	15.00 (22.58)	15.00 (21.41)	12.20 (19.35)	12.20 (16.96)	12.20 (18.26)	12.20 (17.92)
viii	Commission agent and market fee	10.00 (14.01)	10.00 (13.35)	10.00 (15.05)	10.00 (14.28)	7.56 (11.99)	7.56 (11.32)	7.56 (11.32)	7.56 (11.10)
ix	Total cost	71.42 (100.00)	74.89 (100.00)	66.44 (100.00)	70.04 (100.00)	63.06 (100.00)	66.81 (100.00)	66.81 (100.00)	68.10 (100.00)
x	Average price received by the farmers	125.00	125.00	125.00	125.00	94.50	94.50	94.50	94.50
xi	Net returns	53.58	50.11	58.56	54.96	31.44	22.57	27.69	26.40

Source: Field Survey, 1995

Note: Figures in parentheses are percentages

income from fruit cultivation has encouraged many households to buy tractors, vans, and trucks in order to transport apples and supply construction materials. This has helped to expand services in the tertiary sector such as marketing, i.e., for traders and contractors. It has also promoted dairy farming; since good quality grasses are available in the orchards practically all households have purchased improved animals and sell milk, for which there is a huge demand. Another recent impact, though not very strong, is the establishment of small shops and factories to process fruits and make products such as juices, jams, and pickles. These activities are likely to expand in the future because of the ongoing process of liberalisation. Many private entrepreneurs have sought the permission of the government to start fruit processing units. Another very powerful impact of the spread of apple cultivation is the establishment of big marketing centres in the area to cater for the high demand for modern consumer goods. This in turn has provided many people with their livelihoods. The introduction of high-value cash crops has also given rise to a very powerful rural-urban nexus. Almost all fruit growers visit Delhi in connection with the marketing of their produce. It has affected the lifestyles of the local people in many ways; most modern goods can

be seen in these areas. The high literacy rate in the transformed areas can mainly be attributed to a substantial increase in incomes at household level; there is a mushrooming of private English schools in the area. Though indirectly, it has also contributed to the promotion of other related activities, e.g., tourism. Land prices have skyrocketed, and many big hotels and restaurants have been opened, providing the local people with employment opportunities.

The diverse livelihood systems adopted by the households, as discussed in Chapter 4, have implications for different dimensions of sustainability, namely, natural resource base, equity, and quality of life. Some indicators related to these three dimensions of sustainability are discussed in the present chapter.

Crop cultivation, a dominant production option practically in all mountainous regions, though hampered by inaccessibility, marginality, and fragility, has adverse ecological implications. As is well documented by now, the cultivation of animals on steep and steep-sloping lands causes soil erosion, landslides, and environmental degradation. Therefore, from the sustainability perspective, among the different livelihood options, the cultivation of fruit crops is more sustainable than other options. Furthermore, recent development projects, most notably the introduction and every increasing requirement of wooden boxes with cardboard boxes for packing apples, recycling of packing boxes, and export of timber from neighbouring states, have lessened the dependence on trees/crops on natural resources, mainly forests, thereby enhancing the sustainability prospects.

Livestock are yet another dominant production option in mountainous regions, and the study areas were no exception. In this regard, recent developments again, particularly in the transformed areas, for instance the sharp decline in the number of animals, improvement in their quality as a result of the complete replacement of local animals with improved animals, switching over to stall feeding, and a better market for dairy products, have made the livestock production option economically viable and also compatible with the natural resource base of the local area and have enhanced its sustainability. In comparison, in the non-transformed areas, a high livestock population, poor quality of livestock, and grazing practices result not only in low production but also in degradation of pastures and grazing lands.

The remaining livelihood options, in particular, businesses and shops and agricultural and non-agricultural labour, have better prospects for sustainability because they are tertiary in nature and much less dependent on the natural resource base. It, however, needs to be underlined that these options are direct manifestations of the forward and backward linkages generated by the dominant production option of high-value cash crops. Their sustainability, therefore, hinges on the sustainability of high-value cash crops.

Ecological Indicators

Different indicators reflecting ecological health and the status of the natural resource base in the transformed and non-transformed areas are given in Tables 38 and 39 respectively.

ECOLOGICAL, ECONOMIC, AND SOCIAL DIMENSIONS OF SUSTAINABILITY — SOME INDICATORS

The diverse livelihood options adopted by the households, as discussed in Chapter 4, have implications for different dimensions of sustainability, namely, natural resource base, equity, and quality of life. Some indicators related to these three dimensions of sustainability are discussed in the present chapter.

Crop cultivation, a dominant production option practically in all mountainous regions, characterised by inaccessibility, marginality, and fragility, has adverse ecological implications. As is well documented by now, the cultivation of annuals on marginal and steep sloping lands causes soil erosion, landslides, and environmental degradation. Therefore, from the sustainability perspective, among the different livelihood options, the cultivation of fruit crops is more sustainable than other options. Furthermore, recent developments, most notably the introduction and ever-increasing replacement of wooden boxes with cardboard boxes for packing apples, recycling of packing boxes, and import of timber from neighbouring states, have lessened the dependence of these crops on natural resources, mainly forests, thereby enhancing the sustainability prospects.

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Ecological Indicators

Different indicators reflecting ecological health and the status of the natural resource base in the transformed and non-transformed areas are given in Tables 38 and 39 respectively.

Table 38: Ecological Dimensions of Sustainability: Micro-Level Indicators from the Transformed Areas

S. No.	Indicators	Process of Change and Implications
1.	Decline in the livestock population	The decline in the livestock population per household along with the complete switch over to stall feeding have reduced the pressures on natural resources. The quality of livestock has also improved leading to higher yields. These changes augur well for the ecology and environment of the area.
2.	Abandoned land	There is no abandoned land; in fact every inch of land is used. Marginal and steep sloping lands have been brought under apple cultivation.
3.	Land under irrigation	Almost all the land is under irrigation. The irrigation scheme is functioning well and is managed by the Department of Irrigation and Public Health.
4.	Water from natural sources	There is no perceptible change in the amount of water available from natural water sources. In fact, the pressure on these sources has lessened because of the provision of piped water to all villages.
5.	Frequency of landslides and soil erosion	There is no visible change in the frequency and intensity of landslides. Apple cultivation has helped to check landslides and soil erosion. The cropping intensity has declined. The orchards have thick grass cover which protects the soil.
6.	Support land	The amount of support land in terms of pastures and grasslands available per hectare of agricultural land has declined to 0.11 hectares.
7.	Decline in people's participation in the management of community resources	The concern for maintaining natural and community resources has declined. People now do not take interest in the maintenance of forests, water resources, etc, and a feeling of insouciance is pervasive.
8.	Increase in the time devoted to fuelwood and fodder collection	Though the time required to fetch fuelwood and fodder has doubled; peoples' dependence on forests has declined because of replacement of fuelwood, partly with liquid petroleum gas (LPG) and partly with the pruned branches from orchards. People have also started planting Poplar and Alder trees for fuelwood. Further, because of the decline in the number of animals per household and improvement in their quality, fodder requirements have declined. Most of the requirements are met from the grass grown in the orchards.
9.	Use of chemical fertilizers and farmyard manure	The people of the area use fertilizers and are aware of the harmful effects of the excessive use of chemical fertilizers. To minimise these adverse effects they have started using more FYM and compost along with balanced use of chemical fertilizers.
10.	Demand for timber for house construction	In earlier times, the houses were made of wood and stone. Nowadays, they are made of bricks, cement, iron, and steel. This has reduced the demand for timber considerably.
11.	Crop yields	The crop yields are very high and have increased over time, primarily because of the increase in use of modern inputs.
12.	Cropping patterns	The cropping patterns of the area conform to the mountain specificities, i.e., marginality, fragility, and niche. This has led to a fall in the cropping intensity causing less soil erosion. In these areas, economic self-interest and ecology appear to be in complete harmony, i.e., farmers shifting from annual crops to tree-based farming systems.

Table 38 Cont.....

S. No.	Indicators	Process of Change and Implications
13.	Biodiversity	The excessive use of chemicals and sprays of insecticides and pesticides has taken a heavy toll of the rich biodiversity of the area. Honeybees have been killed. Predators and useful insects have been destroyed. This has started affecting apple production. To sum up, harnessing of the local niche (comparative advantages) has affected biodiversity in two ways: First, reduction in the number of crops grown, second, destruction of predators and useful insects.
14.	Investment in agriculture	Investment in making permanent improvements on land such as bunding, terracing, and so on constitutes about 30 to 40 per cent of the total income. The farmers are aware of the importance of maintaining/improving the productivity of the land and hence the need for adequate investment.
15.	Demand for wooden boxes for packing fruits	As noted above, in the 1960s and 1970s local forest resources were used for packing cases. This has an adverse effect on the forests of the area. Now, the practice of allotting timber from local forests for manufacturing boxes has been stopped by a complete ban on felling trees. As an alternative to this, cardboard boxes are being supplied to the farmers. As a result, out of the total boxes used, nearly 20 per cent are cardboard boxes, 20 to 30 per cent are recycled and supplied by middlemen from Delhi, and the remaining 50 per cent demand is met by importing Eucalyptus timber from the main adjoining areas of Haryana and Punjab. In brief, apple cultivation might have depleted forest reserves in the beginning, but, over time, cardboard boxes and other alternatives have reduced the dependence on forests for horticultural purposes.

Source: Field Survey, 1995

Equity

Both intra- and inter-generational equity is one of the most important prerequisites to sustainable development. The process of economic transformation, accompanied by widening inequalities, is inherently unstable. For example, agricultural development that dispossesses large numbers of marginal and small farmers and makes income distribution more inequitable cannot be sustained in the long run. In fact, some scholars have argued that the ideal solution to ensuring sustainable development lies in facilitating the equitability of the system, even at the cost of sacrificing some productivity (Conway 1990, pp 36-37; Redclift 1987, pp 19-20). In this context, different equity indicators, relating to both the transformed and non-transformed areas, are given in Tables 40 to 42. It shows that the process of economic transformation has not exacerbated intra-household inequalities. On the contrary, there are fewer inequalities in the transformed areas than in the non-transformed areas. For example, in the former areas, income distribution, measured by the Gini ratio, is less skewed, male-female wage differentials are less pronounced, and female literacy is significantly higher. Contrary to the prevailing opinion that the commercialisation of agriculture, consequent to the introduction of high-value cash crops, tends to marginalise women, the evidence shows that the transformation process has improved employment opportunities for them. Women now, particularly those belonging to lower castes and those

Table 39: Ecological Dimensions of Sustainability: Micro-Level Indicators from Non-transformed Areas

S. No.	Indicators	Process of Change and Implications
1.	Decline in the livestock population	The livestock population has declined over time. Milk production has also declined for two reasons. First, decline in the grazing land and the availability of fodder, second, the low quality of livestock.
2.	Abandoned land	There is no abandoned land
3.	Land under irrigation	There is no irrigation. However, more recently, because of the implementation of a micro-watershed project in the area, efforts have been made to store rain water and use it for irrigation during the dry season.
4.	Water from natural sources	There has been no perceptible change in the amount of water available from natural sources.
5.	Landslides and soil erosion	There has been no noticeable increase in the intensity and frequency of landslides and soil erosion thanks to the measures adopted by the farmers, e.g., terracing, bunding, and avoiding cultivation on steep slopes.
6.	Support land	The amount of support land in terms of pastures and grasslands has declined over time. One hectare of agricultural land has 0.45 hectares of support land, which is much less than desired. It is, however, much higher than in the transformed areas.
7.	People's participation in the management of community resources	People's participation in the management of common resources, e.g., forests and water, has declined.
8.	Time devoted to fuelwood and fodder collection	Time devoted to the collection of fuelwood and fodder has increased from about 2-3 hours two decades ago to about 4-6 hours now.
9.	Use of chemical fertilizers and farmyard manure	The farmers of the area, though they are poor and have low yields, prefer FYM to chemical fertilizers. The majority of farmers are fully aware of the harmful effects of chemical fertilizers on soils. Recently, because of the decline in the number of animals, they have started making compost to compensate for the loss of FYM.
10.	Demand for timber for house construction	There is a huge demand for timber for house construction. To construct a moderate house requires 8 to 10 full-grown deodar trees. With some improvements in the economic status of the households, demand for timber has increased considerably. Since there is no link road to transport cement, iron and steel and bricks, dependence on the forest has increased leading to overexploitation.
11.	Investment in agriculture	The investment in agriculture is about 10 to 15 per cent. Happily farmers are aware of the need for maintaining the productive capacity of the land and invest in terracing, bunding, etc.
12.	Grazing of animals	Grazing of animals is a common practice; on an average, animals are left to graze 5 to 6 hours every day.
13.	Cropping pattern	There is a significant proportion of cultivated land under annual crops, and this has adverse implications on the ecology and environment of the area. The plantation of fruit crops, such as apples, particularly on marginal land, has helped check soil erosion. Again, nearly one-fifth of the total land is under pastures and grasslands and this helps to check soil erosion.

Table 39 Cont.....

S. No.	Indicators	Process of Change and Implications
14.	Fuelwood consumption	There is a very high dependence on forests for fuelwood. The average household fuelwood consumption is about 4-5 quintals per month, and 90% of the total requirement is met from the forests. This huge demand cannot be sustained and has adverse ecological implications.
15.	Crop yields	The crop yields are very low compared to the transformed areas. This is partly due to the low use of chemical fertilizers and, while it bodes well for sustainability, the high incidence of poverty requires the increased use of fertilizers and other modern inputs to raise the living standards of the population, as emphasised by the World Commission on Environment and Development.
16.	Biodiversity	The biodiversity in the area, though less affected than in the transformed areas, has shrunk over time. The cultivation of traditional millet crops is fast declining. The encroachment on common property land and excessive dependence on forests are also affecting biodiversity adversely.

Source: Field Surve, 1995

from landless households, are economically more independent than ever before and enjoy a higher standard of living than their counterparts in non-transformed areas. These developments have far-reaching implications on the rearing of children, adoption of family planning, education of children, and so on, and these are well documented in the literature. Another redeeming feature, which augurs well for sustainable development, is that women in the transformed areas take part in a large number of activities, such as managing shops and businesses, marketing goods, and so on, which used to be in the male domain until a few years back.

In brief, micro-level evidence from the transformed areas disproves the generally accepted belief that, when small farmers commercialise, they increasingly dispossess land, suffer unemployment, succumb to malnutrition, and have reduced access to food. The data also lend credence to the hypotheses set out in Chapter One, that, in the process of economic transformation consistent with mountain specificities, some endogenous factors operating expressly on the demand side, most notably improvement in human capital; change in the composition, quality, and pattern of rearing livestock; substitution of fuelwood with kerosene and LPG; and substitution of natural products with synthetic products, e.g., wooden boxes by cardboard boxes, are created which ease the pressure on natural resources and thereby promote sustainable development.

The Quality of Life

This is yet another important factor that directly impinges upon the sustainability of any system. The expenditure on superior grains, education, health, shelter, clothing, *inter alia*, reflects the quality of life of the people. The evidence in this regard shows that people in the transformed areas (Table 43) enjoy a much better quality of life than their counterparts in the non-transformed areas. As shown in tabulated form, per household expenditure on superior grains, which include

Table 40: Social Dimensions of Sustainability: Micro-Level Indicators from the Transformed Areas

S. No.	Indicators	Process of Change and Implications
1.	Food habits	There is a drastic change in the food habits of the people. About two decades ago millet, barley, and corn used to be the main foodgrains, whereas wheat and rice are the main foodgrains today. In addition, meat, eggs, fruit, and vegetables are also important dietary components.
2.	Health status	The general health status of the people has improved significantly. The incidence of disease has gone down. Since the income of the people has increased, they can now afford better health facilities.
3.	Water and land-related disputes	There is no evidence of a significant increase in water and land-related disputes.
4.	Social values	Economic prosperity ushered in by the introduction of cash crops has, however, dealt a severe blow to the social cohesiveness and values. The people have become more individualistic in outlook. The society is becoming afflicted by many evils, e.g., a very high incidence of alcohol consumption. Social institutions such as community participation in the management of natural resources, labour exchange system, and so on are fast disappearing.
5.	Female literacy and social status	Literacy and general awareness among females have increased. They actively participate in household decisions. This is evident from the fact that polygamy, which was common twenty years back, has completely disappeared. The appreciation and increasing acceptance of small family norms is yet more evidence of the improved status of women.
6.	Changes in the attitude of the people	There is a remarkable change in the attitude of the people. For example, untouchability is on the wane; people have become much more receptive to innovations and new ideas. The people of the area often visit the regional research stations of the Indian Agricultural Research Institute, Himachal Pradesh Agricultural University, and the University of Horticulture and Forestry located in the area to educate themselves about innovations.
7.	Female-headed households	The number of female-headed households has declined over time. The incidence of male outmigration is much less. Due to the spread of apple cultivation, many male members who were in the services and posted outside have left their jobs to look after their family farmlands which are now converted into fruit orchards.
8.	Joint family system	The joint family system has disappeared. Practically all the families are nuclear.

Source: Field Survey, 1995

wheat and rice, and expenditure on education and clothing are substantially higher in the transformed area. Likewise, the availability and use of facilities such as telephones, LPG, and television and better built, better quality residential housing in these areas speak volumes about the quality of life being enjoyed. On the other hand, in the non-transformed areas, people, particularly small and marginal households, are barely surviving. Expenditure on superior grains, education, and clothing is extremely low and some families remain perpetually in debt. The detailed consumption patterns of the households in both areas have been provided in Table 44.

Table 41: Social Dimensions of Sustainability: Micro-Level Indicators from the Non-transformed Areas

S. No	Indicators	Process of Change and Implications
1.	Food habits	Food habits have changed from traditional millet to corn and wheat. Expenditure on pulses, fruit, and vegetables, though very low, has increased over time.
2.	Health status	There is not much improvement in the health status of the people.
3.	Social values	Though social values have tended to change, the extent of social disintegration is much less than in the transformed areas. Social institutions, such as labour sharing, are still functioning effectively. Likewise, the incidence of social crimes is also less.
4.	Female literacy	Female literacy is very low. The practice of polygamy, though declining, is still there. Nearly 40 per cent of the households involve females in household decision-making. The society continues to be male dominated.
5.	Attitudes of the people	The people of the area are very conservative and averse to risk. They do not like to move out for jobs or land labour work to the towns and cities. The practice of untouchability is strictly followed.
6.	Female-headed households	There is no noticeable increase in the number of female-headed households. Despite the lack of employment opportunities, males do not like to migrate. Thus there are not many female-headed households.
7.	The joint family system	The joint family system has not disappeared completely; nearly 40 per cent of the households have joint families.

Source: Field Survey, 1995

Sustainability Perceptions

From the policy perspective, it is essential to understand households' perceptions of basic needs, the time horizon regarding the needs of future generations and the types of assistance they require to promote sustainable development. In fact, guided by past experience, failure to promote sustainable development could primarily be attributed to the hiatus and mismatch between the objective functions of households at the grassroots' level and those of policy-makers. Therefore, to gain insight into the farmers' perceptions about various aspects impinging on the sustainability of a production system, their views were elicited. The details are given in Table 45. The following comments are in order.

First, there is a significant difference between the transformed and non-transformed areas in households' perceptions regarding the satisfaction of present and future needs. For example, half of the small and medium households in the latter areas are concerned with meeting their present needs. This supports the belief that, in poor and backward regions, the satisfaction of immediate needs is the primary concern of households. In any case, it is important to underline that the households' concerns do not extend beyond satisfaction of the needs of two generations.

Second, whereas, in the transformed areas, ensuring food security and provision of education are deemed to be the two most important needs for future genera-

Table 42: Implications for Equity

S. No.	Particulars	Status	
		Transformed Areas	Non-transformed Areas
1.	Male wages (Agricultural)	IRs 30.00	IRs 25.00
2.	Female wages	IRs 25.00	IRs 20.00
3.	Income distribution (Gini Ratio)	0.37	0.40
4.	Female literacy	42.62	34.18
5.	Male literacy	60.09	53.48
6.	Percentage of female participation in household decisions	90.00	40.00
7.	Sexual division of labour	Less activities exclusively performed by males; females are often seen managing the shop, etc	Rigid and less flexible sexual division of labour.
8.	Female employment	The introduction of new cash crops has opened up opportunities for female employment. For example, many women earn handsome amounts by working in apple orchards.	Such changes are discernible in the non-transformed areas as well but the impact is much less pronounced
9.	Percentage of females having secondary and higher level education	41.34	12.96
10.	Percentage of school-going children		
	Males	100.00	100.00
	Females	100.00	100.00

Source: Field Survey, 1995

tions, in the non-transformed areas, the satisfaction of all basic needs is considered of utmost importance.

Third, it is interesting to note that a significant proportion of households in the transformed areas does not want subsidies from the government. They feel that, in the garb of subsidies, sub-standard materials are supplied to them and most of the subsidies are pocketed by a few rich orchardists. What is more important to them is the provision of technical knowhow and basic infrastructural facilities. In contrast, the households in non-transformed areas expect the government to supply all basic facilities, including subsidies.

Fourth, in both types of area, households want equal participation in the management of local natural resources, e.g., forests, water, and common property lands, and also in development activities. They attribute the failure of government-sponsored schemes to insensitivity to and alienation from local needs and potentials.

Table: 43: Impact on the Quality of Life

S. No	Particulars	Transformed Areas (Farmers)				Non-transformed Areas (Farmers)			
		Small	Medium	Large	All HHs	Small	Medium	Large	All HHs
1.	Expenditure on superior grains	4838 (10.00)	5064 (8.70)	7111 (10.84)	5124 (10.49)	3292 (15.34)	3617 (11.39)	4071 (10.91)	3461 (13.40)
2.	Access to food (%age of HH)	100.00	100.00	100.00	100.00	100.00	100.00	100.00	100.00
3.	Expenditure on clothing	4445 (9.93)	5563 (9.56)	6000 (9.14)	4765 (9.75)	2418 (11.26)	3738 (11.77)	5000 (13.40)	3040 (11.76)
4.	Expenditure on milk & milk products	10286 (22.97)	13870 (23.82)	19345 (29.48)	11771 (24.09)	1540 (7.17)	4677 (14.73)	5475 (14.67)	2774 (8.80)
5.	Expenditure on meat, fish and eggs	1942 (4.34)	4125 (7.09)	3000 (4.57)	2344 (4.81)	667 (2.93)	1463 (4.60)	1114 (2.98)	893 (3.46)
6.	Expenditure on fruit and vegetables	2169 (4.84)	3263 (5.60)	2769 (4.22)	2378 (4.87)	539 (2.51)	1005 (3.16)	891 (2.39)	697 (2.70)
7.	Expenditure on education	4947 (11.05)	6038 (10.37)	5714 (8.70)	5174 (10.59)	1668 (7.77)	1944 (6.12)	2457 (6.58)	1826 (7.07)
8.	Expenditure on health	1146 (2.56)	1150 (1.98)	1429 (2.18)	1174 (2.40)	1497 (6.98)	1772 (5.58)	1743 (4.67)	1594 (6.17)
9.	Value of residential houses (per HH, IRs)	100170	112500	207143	113839	41150	72500	110000	56762
10.	Percentage of HHs using LPG	37.78	50.00	57.14	43.33	-	-	-	-
11.	Percentage of HHs having telephone connections	17.78	37.50	28.57	21.67	-	-	-	-
12.	Percentage of HHs having television	100.00	100.00	100.00	100.00	12.50	25.00	42.86	20.00
13.	Literacy level (per cent)	51.62	48.28	59.29	52.19	35.38	32.73	20.95	44.64
14.	Percentage of HHs in debt	6.67	-	-	5.00	37.50	37.50	-	35.00
15.	Percentage of HHs without electricity	-	-	-	-	17.50	-	-	11.67
16.	Percentage of HHs below poverty line	-	-	-	-	40.00	14.28	-	30.00

Source: Field Survey, 995

Table 44: Consumption Patterns of Sample Households

Particulars	Transformed Areas				Non-transformed Areas			
	Small	Medium	Large	All HHs	Small	Medium	Large	All HHs
A. Food Items								
1. Cereals								
(i) Wheat	1975 (4.41)	2184 (3.75)	2585 (3.94)	2071 (4.24)	2522 (11.75)	2430 (7.65)	2914 (7.81)	2542 (9.84)
(ii) Maize	910 (2.03)	1073 (1.84)	864 (1.32)	926 (1.90)	2312 (10.77)	2389 (7.52)	3454 (9.26)	2458 (9.51)
(iii) Rice	2863 (6.39)	2880 (4.95)	4526 (6.90)	3053 (6.25)	770 (3.58)	1187 (3.74)	1157 (3.10)	919 (3.55)
2. Pulses	2747 (6.14)	3630 (6.24)	3771 (5.75)	2977 (6.09)	1166 (5.43)	1661 (5.23)	2529 (6.78)	1440 (5.57)
3. Oil & Ghee	1780 (3.98)	2310 (3.97)	2914 (4.44)	1976 (4.04)	1836 (8.55)	2996 (9.43)	3127 (8.38)	2274 (8.80)
4. Milk	10286 (22.97)	1387050 (23.82)	19345 (29.48)	11771 (24.09)	1540 (7.17)	4677 (14.73)	5475 (14.67)	2774 (10.73)
5. Meat, Fish, Eggs	1942 (4.34)	4125 (7.09)	3000 (4.57)	2344 (4.80)	627 (2.92)	1463 (4.61)	1114 (2.99)	893 (3.46)
6. Sugar	1897 (4.24)	1808 (3.10)	3797 (5.79)	2100 (4.30)	1019 (4.75)	1635 (5.15)	1569 (4.20)	1236 (4.78)
7. Beverages	489 (1.09)	533 (0.92)	857 (1.31)	537 (1.10)	312 (1.45)	566 (1.78)	677 (1.81)	417 (1.61)
8. Fruit and Vegetables	1169 (4.84)	3263 (5.60)	2769 (4.22)	2378 (4.87)	539 (2.51)	1005 (3.16)	891 (2.39)	697 (2.70)
9. Total Expenditure	27058 (60.43)	35676 (61.28)	44428 (67.71)	30133 (61.68)	12643 (58.89)	20009 (63.01)	22908 (61.40)	15650 (60.56)
B. Non-food Items								
1. Clothing	4445 (9.93)	5563 (9.56)	6000 (9.14)	4765 (9.75)	2418 (11.26)	3738 (11.77)	5000 (13.40)	3040 (11.76)
2. Education	4947 (11.05)	6038 (10.37)	5714 (8.70)	5174 (10.59)	168 (7.77)	1944 (6.12)	2457 (6.58)	1826 (7.07)
3. Health	1146 (2.56)	1150 (1.98)	1429 (2.18)	1174 (2.40)	1497 (6.98)	1772 (5.58)	1743 (4.67)	1594 (6.17)
4. Transport	1405 (3.14)	1431 (2.46)	1286 (1.96)	1395 (2.86)	464 (2.16)	769 (2.42)	1029 (2.76)	604 (2.34)
5. Social ceremonies	2210 (4.94)	3063 (5.26)	1686 (2.57)	2260 (4.63)	1076 (5.01)	1076 (5.01)	1759 (4.71)	1243 (4.81)
6. Fuel and electricity	1460 (3.26)	2200 (3.78)	1764 (2.69)	1590 (3.25)	276 (1.29)	276 (1.29)	524 (1.40)	332 (1.28)
7. Oil, Soap etc.	743 (1.66)	1208 (2.07)	837 (1.28)	814 (1.67)	302 (1.41)	302 (1.41)	471 (1.26)	348 (1.35)
8. Miscellaneous	1357 (3.03)	1888 (3.24)	2471 (3.77)	1551 (3.17)	1128 (5.25)	1128 (5.25)	1428 (3.83)	1204 (4.66)
Total Expenditure on Non-food Items	17714 (39.57)	22542 (38.72)	21187 (32.29)	18724 (38.32)	8829 (41.11)	8829 (41.11)	14411 (38.60)	10191 (39.44)
Grand Total	44772 (100.00)	58218 (100.00)	65615 (100.00)	48856 (100.00)	21472 (100.00)	21472 (100.00)	37318 (100.00)	25841 (100.00)

Source: Field Survey, 1995

Note: Figures in parentheses are percentages.

Table 45: Sustainability Perceptions of Sample Households (Per Cent Households)

S. No	Particulars	Transformed Areas				Non-transformed Areas			
		Small	Medium	Large	All HHs	Small	Medium	Large	All HHs
1.	Time perspective Should be able to satisfy-								
	i) present needs	-	-	-	-	50.00	43.75	-	42.86
	ii) future needs	100.00	100.00	100.00	100.00	50.00	56.25	100.00	57.14
	a) two generations	-	-	-	-	-	-	-	-
	b) more than two generations	-	-	-	-	-	-	-	-
	2. Most important for future generations-								
	i) food security	85.11	75.00	71.43	82.23	100.00	100.00	100.00	100.00
	ii) education	80.85	100.00	100.00	85.48	75.00	100.00	100.00	84.13
	iii) health	42.55	50.00	57.14	45.16	100.00	100.00	100.00	100.00
	iv) shelter	46.81	37.50	42.85	45.16	100.00	100.00	100.00	100.00
3.	Support from government to promote sustainability-								
	i) subsidies	49.34	25.00	28.57	45.16	100.00	75.00	57.14	88.89
	ii) technical knowhow	85.11	100.00	100.00	88.71	100.00	100.00	100.00	100.00
	iii) infrastructural facilities	85.11	100.00	100.00	88.71	100.00	100.00	100.00	100.00
4.	Pattern of resource management-								
	i) government	-	-	-	-	-	-	-	-
	ii) people	-	-	-	-	-	-	-	-
	iii) participation of both	100.00	100.00	100.00	100.00	100.00	100.00	100.00	100.00
5.	Indicators of sustainability-								
	i) maintaining land productivity	51.06	100.00	100.00	62.90	75.00	100.00	100.00	84.13
	ii) stability in crop yield	100.00	100.00	100.00	100.00	100.00	100.00	100.00	100.00
	iii) equal distribution	17.02	-	-	12.90	-	-	-	-
	iv) maintenance of biodiversity	8.51	50.00	71.43	20.97	-	-	-	-
	6. Factors contributing to the adoption of superior production options-								
	i) political patronage	100.00	100.00	100.00	100.00	-	-	-	-
	ii) infrastructural facilities	85.11	100.00	100.00	88.71	-	-	-	-
	iii) availability of subsidies	95.74	100.00	100.00	96.77	-	-	-	-
	iv) extension facilities	95.74	100.00	100.00	96.77	50.00	100.00	100.00	52.38
7.	New options cannot be sustained because of-								
	i) lack of availability of packing cases	42.55	-	-	-	-	-	-	-
	ii) fluctuating yields	100.00	100.00	100.00	100.00	100.00	100.00	100.00	100.00
	iii) increasing incidence of diseases	74.46	50.00	28.57	66.13	75.00	56.25	50.00	66.67
	iv) market fluctuations	42.55	-	-	32.26	-	-	-	-

Source: Field Survey, 1995

Fifth, the households view sustainability of any production system in terms of increase in its productivity coupled with its stability. Other important aspects of sustainability, such as biodiversity and equity, are not of much concern to them.

Sixth, in the transformed areas, households perceive factors such as availability of basic infrastructural facilities, subsidies, and extension facilities to have played an important role in popularising high-value cash crops, for instance, apples. On the other hand, availability of extension facilities has been singled out to be the most important factor in the non-transformed areas.

Seventh, in farmers' perceptions, spread of diseases and consequently wide fluctuations in the production of fruit crops are formidable constraints and endanger the sustainability of these crops.

To sum up, there is no significant difference in the perceptions of the households about the diverse aspects impinging on sustainability. The data, however, lend some support to the hypothesis that resource poor households are primarily concerned with meeting their immediate needs.

S. No.	Factor	Transformed Areas		Non-transformed Areas		t-value	Significance
		Mean	SD	Mean	SD		
1	Vegetables	18.94	5.63	16.29	5.57	0.53	ns
2	Fruit	27.08	5.76	24.26	5.62	2.04	**
3	Cereals	65.43	10.26	67.21	11.48	0.24	ns
4	Non-food items	10.01	3.01	10.07	3.07	0.91	ns
5	Health	13.4	3.2	12.2	3.1	1.9	**
6	Transport	1.92	0.81	1.26	0.56	4.9	**
7	Subsidy	4.87	2.2	3.1	1.2	10.7	**
8	Extension	14.24	3.2	12.9	3.1	1.9	**
9	Oil, soap etc.	7.5	2.9	6.7	2.4	3.0	**
10	Machinery	1.97	0.8	1.71	0.7	1.2	ns
Total		147.7	24.8	140.5	23.6	1.3	ns

Source: Field survey, 1990.
 ** - Significant at 5% level of probability.

FACTORS AND PROCESSES OF SUSTAINABLE LIVELIHOOD OPTIONS

In mountainous regions, the process of option enhancement in general and the quality of livelihood options in particular are contingent, to a great extent, on the availability of adequate infrastructural facilities such as roads. It, however, also needs to be mentioned that the introduction of new production options may take place even without the availability of these facilities. For example, apples were introduced into the study areas way back in 1870 by the British, when there were no roads. Experiences in the study areas and several other regions in the HKH, however, suggest that the availability of these facilities is of crucial importance in making these options economically viable and sustaining the process of transformation. Developments do take place in a co-evolutionary manner. For example, people modify their production environment and adapt themselves to emerging situations by developing alternatives, e.g., installing ropeways to transport high-value cash crops to the roadheads. Nonetheless, the lack of adequate facilities affects the quality of livelihood options in a variety of ways, viz., high transport costs, lack of inputs, and so on. There are numerous examples in the literature to suggest that the lack of adequate marketing facilities has obliged the mountain people to abandon high quality production options for which there is a substantial potential comparative advantage. To recall, in the non-transformed areas, apple cultivation has not spread as it did in the transformed areas, primarily because of the lack of adequate transport facilities. As noted above, as much as 23 per cent of the total production and marketing costs of a 20kg apple box is accounted for by the transportation costs up to the roadhead alone, compared to a low three per cent in the transformed areas. Of late, people have tried to overcome these constraints by installing ropeways, but wider use by a majority of small and marginal farmers is still to catch up. In brief, easy availability of transport facilities in the transformed areas, *inter alia*, has set into motion a process of sustainable development ultimately contributing towards improving the quality of livelihood options.

The experience of the transformed areas also brings home the message that to overcome the initial constraints, which are often formidable, political patronage is essential. It may be recalled that initially massive subsidies were given to popularise and promote apple cultivation; subsidies were given on plant nurseries, for digging pits, on inputs, on agricultural implements, and on foodgrains. And, in many cases, apple orchards were planted on private lands by the forest department to encourage people to adopt apple cultivation. In addition, a network of institutions was created by setting up a separate directorate of horticulture as early as 1961, appointing a district horticultural officer, opening a training school to train growers to prepare nurseries and plant the apple orchards. Political patronage has continued in one form or the other; the Himachal Pradesh Horticul-

tural Produce Marketing and Processing Corporation (HPMC) was set up in 1971 with the assistance of the World Bank to provide post-harvest infrastructural facilities such as link roads, cold storage, grading, and packing facilities. The construction of National Highway No. 21 by the central government proved a boon to the area, with no burden on the state exchequer.

A vast network of research and development (R&D) infrastructure has been created to evolve and provide technical knowhow to farmers. The state has established a fully-fledged University of Horticulture and Forestry, which is one of its kind in Asia; the university has set up research stations in all the agroclimatic zones of the state to cater to the technical requirements of fruit growers. In addition, the central government has also established a research station to strengthen R&D facilities in the state; the National Institute of Mushroom Research at Solan, the Regional Research Station of Indian Agricultural Research, and the Institute of Vegetables at Katrian (Transformed Areas) are notable examples. These institutions are playing a catalytic role in promoting the cultivation of horticultural crops in the state by providing technical knowhow to the farmers.

To insulate farmers from the fluctuations in market prices, support prices for various fruit crops have been introduced. To begin with, the HPMC used to purchase fruits offered by the producers to ensure them minimum prices. In more recent times, a market intervention scheme has been introduced under which prices are fixed for various fruits according to their grade and quality, and, if the prices fall below this level, the produce is procured by the state government at fixed prices.

Yet another important factor which also contributed towards the adoption of high-value cash crop (apple) cultivation in the 1960s and 1970s was the enactment and implementation of land reform measures under a directive of the central government. Inasmuch as the ceiling on orchard land was higher, farmers placed their marginal lands under apple cultivation not only to circumvent the ceiling laws but also to overcome the labour shortages as well. The attainment of full statehood in 1971 was yet another important milestone that helped to overcome political marginalisation. The Kullu District has always been represented by a cabinet minister in the state council of ministers. As a result, the problems of fruit growers always received adequate attention from policy-makers. This has helped to resolve the so-called 'Himalayan Dilemma' faced by most of the mountainous regions.

The above-mentioned state government policies have helped to overcome the initial constraints and to introduce a process of agricultural development which is consistent with mountain specificities. The state has acted as a watchdog in the whole process of transformation; political interventions at appropriate times have helped to conserve the natural resource base and thereby promote sustainable agricultural development. For example, the enactment and implementation of stringent forest laws have helped to check deforestation and preserve the forest wealth of the state at an appropriate time. A saying, which has gained currency in recent times, that one can get away with murder but not with cutting down a

tree, goes to prove the effective implementation of forest laws. Restrictions on the felling of forest trees have obliged fruit growers to look for alternative modes of packing fruit.

In the process of transformation, numerous processes have been created in the system itself, creating conditions that are environmentally benign and beneficial to the conservation of the local, natural resource base. For example, with the planting of apple orchards on marginal lands and encroachment on common property resources, grazing land and areas under fodder declined sharply. This, coupled with an improvement in the economic status of the households, led, on the one hand, to a steep fall in the number of animals, particularly sheep and goats, and, on the other, to replacement of low quality animals with improved quality animals. This not only improved livestock productivity but also reduced the environmental degradation commonly associated with excessive livestock populations and overgrazing. There was also not much loss in cowdung because of the complete switch over from grazing to stall feeding. Again, good quality grass is available in the orchards, and this is sufficient to meet about 60 to 70 per cent of the total fodder requirements. In the ultimate analysis, over time the relationship between fruit cultivation and livestock has tended to become mutually supportive and reinforcing, leading to substantial increases in the income of households. In the process of development, self-help institutions have emerged to meet one of the most essential conditions for the process of transformation; i.e., to be enduring and sustainable. The emergence of many cooperatives and the Fruit Growers' Association has played an important role in ensuring that farmers have access to basic facilities such as transportation.

Since sustainable development is a dynamic process, the people of the areas favourably endowed with physical, human, institutional, and social infrastructure continuously evolve and adapt to the changing environment. In our study areas, as is evident from the chronological history of the process of substitution, replacement, and addition to livelihood options, new options have been introduced whenever existing ones became unsustainable; households switched over from potatoes to peas and then to apple production. In recent times, in view of the substantial fluctuations in apple production due to climatic factors and the spread of diseases, households have started exploring alternatives and are fully geared to diversify their production options to dairy production, vegetables, mushrooms, and floriculture to lessen their excessive dependence on apple crops. Such a process is missing in the non-transformed areas, despite the fact that apple cultivation was introduced long ago, i.e., in 1957-58.

To sum up, the development process experienced in the transformed areas was a change in which, in the process of harnessing the local niche, the pattern of investment, the provision of basic infrastructural facilities, and the orientation of research and development networks were in complete harmony. This led to the minimisation of conflicts and tradeoffs between development and environmental conservation and created factors and processes that set mountain agriculture on the road to sustainability.

All is, however, not well. The process of transformation is beset with so-called 'second generation' problems. These problems are usually associated with the transition from subsistence-oriented, traditional cereal-based agriculture to high-value, cash crop-based commercial agriculture; shrinking biodiversity, disruption of social values, and emergence of plant diseases are some of the main problems. The improper use of insecticides and pesticides by farmers has taken a heavy toll on honeybees, predators, and useful insects. Diseases causing substantial fluctuations in the production of apples are now common. Many crops which used to be grown earlier have disappeared, social values indicate the increased level of materialistic and individualistic attitudes.

Mountain areas are characterised by inaccessibility, fragility, marginality, diversity, niche and human adaptation mechanisms, which are sometimes called mountain specificities. They distinguish these areas from the plains. These features have both biophysical as well as sociocultural and economic dimensions. They affect mountain agriculture's capacity to withstand shocks and its resilience to support an ever-increasing population pressure. Consequently, widespread poverty and environmental degradation are ubiquitous features.

The knowledge reviews and empirical work carried out by the Mountain Farming Systems' Division of ICIMOD in different parts of the Hindu Kush-Himalayan region have shown that sustainability of mountain agriculture faces a serious threat which may worsen unless remedial measures are immediately undertaken. This is reflected in the degradation of the natural resource base in terms of increases in the intensity and frequency of landslides, gully formation, soil erosion, reduced per capita availability and fragmentation of land, and so on. This has, *inter alia*, contributed, to a varying degree, to negative trends in the yields of crops and livestock; an increase in drudgery, especially for women in terms of collection of water, fuelwood, and fodder; and low availability of capital for re-investment in agriculture.

While the above-mentioned indicators of unsustainability pervade the whole of the HKH region, some areas have also undergone rapid transformation, thanks to the adoption and implementation of mountain-sensitive development strategies encompassing the mountain perspective. The State of Himachal Pradesh, located in the heart of the western Himalayas, represents one such example with positive features. This is clear from the fact that the state's net domestic product increased two hundred times and net per capita income twenty-six times during the last two decades, when the State attained full statehood in 1971. The quality of life has improved dramatically. The incidence of poverty has declined from one person in every three in 1971 to one in every seven in 1991. Two-thirds of the population are now literate, compared to one-third in 1971, which is higher than the national average of one-half. All villages have been provided with electricity, and more than 95 per cent have access to safe drinking water. These accomplishments have drawn the attention of both scholars and policy-makers to Himachal Pradesh as a model of development in hill areas.

Concerned quarters are keen to understand the factors and processes behind such rapid changes in the State at a time when mountain areas, in general, are witnessing worsening conditions of environmental degradation and a diminishment in the quantity and quality of livelihood options available to mountain people. Against this background, efforts have been made: first, to document the livelihood options of the households and assess their sustainability implications in

terms of the natural resource base, quality of life, and equity aspects and, second, to understand the factors and processes that contributed to the transformation in order to draw policy implications for development interventions elsewhere in the HKH region.

To accomplish these objectives, an empirical study was carried out in the Kullu District of Himachal Pradesh. Two blocks, namely, Naggar and Banjar, were selected to represent the transformed and non-transformed areas, respectively. From the selected blocks, two *panchayat*(s) were selected, again to capture the contrasts in levels of development. Finally, a sample of 125 households was selected at random, 62 from the transformed areas and 63 from the non-transformed areas. The selected households were classified into small, marginal, and large on the basis of their land ownership status; those who owned less than one hectare were designated small farmers, between one to two hectares medium; and those who owned more than two hectares were categorised as large farmers. To capture temporal changes in the natural resource base, 35 key informants were also interviewed, 20 from the transformed areas and 15 from the non-transformed areas.

The conceptual framework developed by the MFS Division of ICIMOD was employed in carrying out the study. Accordingly, while analysing the livelihood options, their implications for quality of life, equity aspects, and the natural resource base were examined. These three conditions, viz., improved quality of life, equity, and natural resource base, are sometimes known as the dimensions of sustainability and constitute an option-screening framework.

The empirical evidence given by the field data indicate no significant differences in the range of livelihood options adopted by the households in the transformed and non-transformed areas. For example, nearly four-fifths of the households in both types of area adopted three to four activities. The evidence, however, did indicate a higher percentage of households (17.46%) adopting a larger number of livelihood options (in the range of five to six) in the non-transformed areas, than in the transformed areas. No household adopted more than six options. There was, however, no relationship between the range of livelihood options and average household and per capita income in the transformed areas. For example, those adopting two options had a higher level of income than their counterparts adopting three to four options; the average household and per capita incomes of those practising five to six livelihood options were again higher. On the other hand, in the non-transformed areas, a direct and positive relationship was observed between the average and per capita income of the households and the range of livelihood options. It is, however, important to note that the average household and per capita incomes for all categories of household in the transformed areas were more than double those of their counterparts in the non-transformed areas. Regarding different livelihood options, two-thirds of the total household income in the transformed areas comes from agriculture-related activities, whereas the share of such activities in the non-transformed areas was less than fifty per cent. Fruit production (mainly apples) alone accounted for more than two-fifths of the total income followed by services and pensions (26%) and livestock and dairy

(nearly 18%). The respective contributions of these activities in the non-transformed areas were 20 per cent, 28 per cent, and 13 per cent.

Among the various indicators of the quality of livelihood options, per day, per worker earnings were a better measure, insofar as they take into account both the amounts of employment and income. Therefore, considering this as a yardstick, livelihood options, namely, fruit production, vegetable production, businesses, and shops, were of very high quality. It should be mentioned that vegetable production, though contributing little towards the total household income and employment, is a very high quality production option and offers considerable scope for diversification in future. The high quality of production options in the transformed areas is also evident from the number of forward and backward linkages generated by them. The quality of livelihood options, measured by per worker, per day earnings, was very low in the non-transformed areas. Some of the options, such as livestock activities and dairy farming, agriculture, weaving, and agricultural labour, were distress driven and undertaken primarily with a survival motive. At the household level, factors such as the availability of land, labour, amount of assets, and number of educated members in the family, were significant in determining the number of livelihood options adopted by a household.

A variety of factors, such as the low quality of livestock, low use of modern inputs, low level of education, and so on, contributes to the low quality of livelihood options in the non-transformed areas. The most important factor is, however, the inaccessibility constraint, which is a ubiquitous constraint in all mountainous regions. This is demonstrated by the fact that, in the non-transformed areas, whereas there is not much difference between different cost components of the total production and marketing costs, for instance of a 20kg box of apples, the cost of transportation up to the roadhead alone accounts for 23.48 per cent compared to a low three per cent in the transformed areas.

To reiterate, the different livelihood options were screened for their sustainability implications by following the framework developed by ICIMOD. The evidence in this case shows that the quality of life of the people, by all reckoning, has improved dramatically in the transformed areas. For example, households in these areas spend nearly 50 per cent more on superior grains and clothes than those in the non-transformed areas. The most notable differences are discernible in the consumption of milk and dairy products (300%), meat products (150%), and fruit and vegetables (240%), which are all high income elasticity products. Similarly, expenditure on health in the transformed areas is much lower than in the non-transformed areas. The improved level of welfare in the former areas is also evident from the increased level of literacy in general and female literacy in particular, disappearance of poverty, and a decreased level of land and water disputes. Equity, one of the important prerequisites for sustainable development, is also taken into account. For instance, the Gini coefficient of the distribution of per capita household income is 0.37 in the transformed areas compared to 0.40 in the non-transformed areas.

Evidence regarding impact on the natural resource base, the most important aspect of sustainability, is also positive. The process of transformation has not led to deterioration in the natural resource base. On the contrary, because of better management of demand factors, processes have been generated that have lessened the burden on natural resources. An increasing shift to other energy sources, hundred per cent electrification, growing substitution of wooden boxes for packing with corrugated fibre cartons, import of timber from the neighbouring states and recycling of wooden boxes, reduction in the number of livestock per household, and switching over to stall feeding from grazing are some of the important examples of better demand management. On the supply side, the livelihood options are in complete conformity with the development imperatives of mountain specificities, namely, inaccessibility, marginality, fragility, diversity, and niche. Fruit crops are, for example, perennial in nature and help to reduce cropping intensity and check soil erosion. Livestock farming based on stall feeding helps to maintain the forests and pastures.

It, however, should be stressed that sustainability is a dynamic phenomenon and a process of change. And any activity which is sustainable today may not remain sustainable for all times to come, because of a variety of factors, e.g., unrelenting population pressure, changes in the people's needs and perceptions, market integration from local to national and then to international, and changes in technology and market conditions. What is essential therefore is the promotion of option enhancement by building up basic infrastructure! — physical, institutional, and social — facilities, providing the latest technical knowhow through a sound R&D network, and strengthening human capital. In the transformed areas, because of the easy availability of the above noted infrastructural facilities, households are actively exploring alternatives to diversify their economic activities to floriculture, vegetables, dairy production, and also to non-farm activities in order to reduce their dependence on apple crops, because the production has become very unstable due to the spread of diseases.

The adoption of development strategies in conformity with mountain specificities has been the single most important factor in introducing the process of sustainable development; a development strategy, *inter alia*, focussed on the provision of sound physical and institutional infrastructure. The provision of huge subsidies, setting up of a separate directorate of horticulture in 1961 and later HPMC in 1972, and a training school to train fruit growers were some of the important landmarks in the development strategy which facilitated the spread of high-value cash crops. In the process, self-help institutions have emerged to promote the process of sustainable development.

To sum up, the whole debate on sustainable mountain agriculture centres around promoting farming systems that are consistent with mountain specificities, both constraints, such as inaccessibility, marginally, and fragility, and opportunities, such as niche, diversity, and human adaptation mechanisms, and which are also high yielding and eco-friendly. In this context, the micro-level evidence emanating from the study areas reveals that the introduction of high-value cash crops appears to be sustainable, both economically and ecologically. It further needs to

be underlined that sustainability is a dynamic and continuous process. And an activity which is sustainable today may not remain so for all times to come because of developments, e.g., change in technology, prices, integration of the local market with the national and international markets, and so on. It, however, comes out very clearly, as emphasised by the WCED definition of sustainable development, that once the basic needs of the people, e.g., food, clothing, and shelter, are satisfied, they tend to take care of their natural resources and environment to ensure that the needs of future generations are met. In other words, this helps to break the so-called 'poverty-environmental degradation-resource scarcity-poverty cycle' and put the system further on the path of sustainable development. It also needs to be underlined that the State has to play a very vital role in overcoming the constraints, e.g., providing basic infrastructural facilities to initiate the process of development. The indicators by which we have measured the process of sustainability, particularly relating to the quality of life, are comparative. For example, to an outsider, the amount of household expenditure on grains, clothing, housing, and so on may not qualify as sustainable but, compared to the non-transformed areas, these certainly indicate a qualitative improvement.

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ICIMOD

ICIMOD is the first international centre in the field of mountain development. Founded out of widespread recognition of environmental degradation of mountain habitats and the increasing poverty of mountain communities, ICIMOD is concerned with the search for more effective development responses to promote the sustained well being of mountain people.

The Centre was established in 1983 and commenced professional activities in 1984. Though international in its concerns, ICIMOD focusses on the specific, complex, and practical problems of the Hindu Kush-Himalayan Region which covers all or part of eight Sovereign States.

ICIMOD serves as a multidisciplinary documentation centre on integrated mountain development; a focal point for the mobilisation, conduct, and coordination of applied and problem-solving research activities; a focal point for training on integrated mountain development, with special emphasis on the assessment of training needs and the development of relevant training materials based directly on field case studies; and a consultative centre providing expert services on mountain development and resource management.

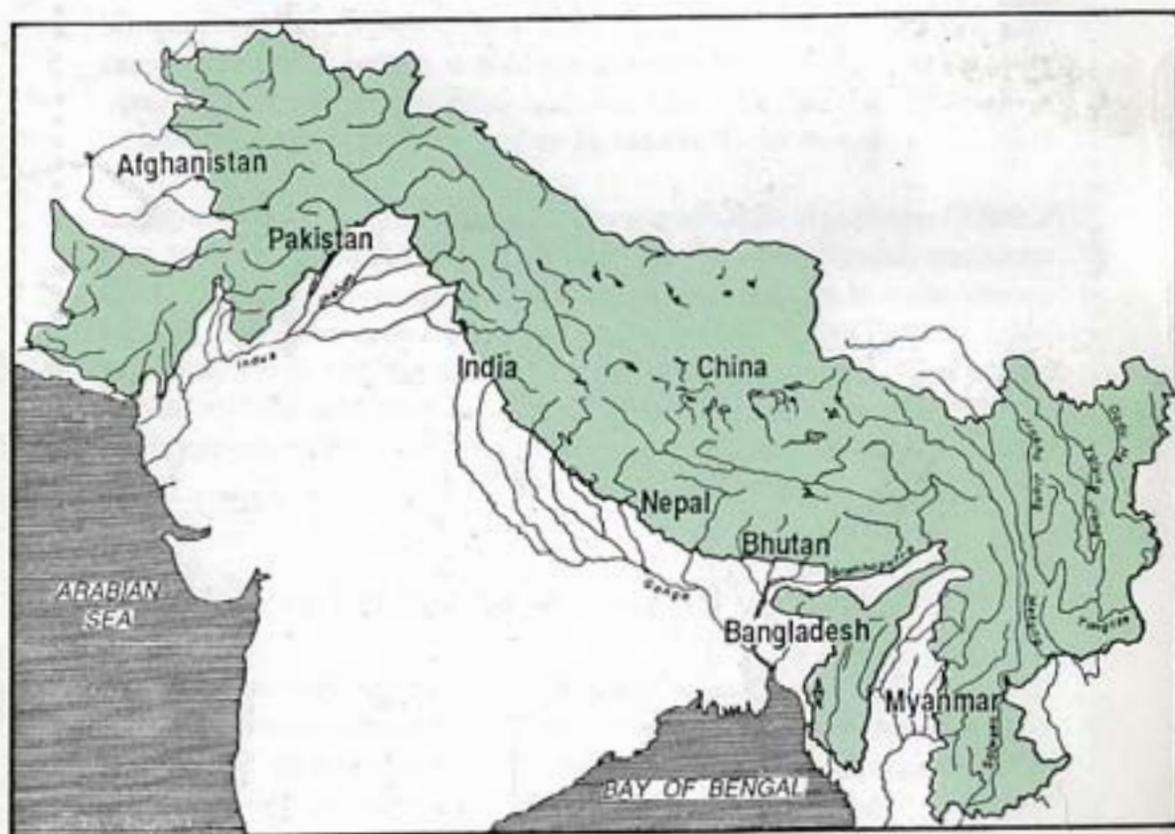
MOUNTAIN FARMING SYSTEMS' DIVISION

Mountain Farming Systems constitutes one of the thematic research and development programmes at ICIMOD. The medium-term objectives of the programme include i) Appropriate Technologies for Sustainable Mountain Agriculture, ii) Institutional Strengthening for Mountain Agriculture, iii) Integration of Gender Concerns into the Development of Sustainable Mountain Agriculture, iv) Agricultural Research Networking, and v) Better Understanding of Sustainability Dimensions.

PARTICIPATING COUNTRIES of the HINDU KUSH-HIMALAYAN REGION

- ❖ AFGHANISTAN
- ❖ BHUTAN
- ❖ INDIA
- ❖ NEPAL

- ❖ BANGLADESH
- ❖ CHINA
- ❖ MYANMAR
- ❖ PAKISTAN



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